Hilmert

Bradley

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TRANSCRIPT OF RECORD.

SUPREME COURT OF THE UNITED STATES.

No. 299.

THE SWAIN TURBINE AND MANUFACTURING COMPANY, APPELLANT,

vs.

JAMES E. LADD.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE DISTRICT OF MASSACHUSETTS.

FILED OCTOBER 15, 1877.

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1*a* UNITED STATES OF AMERICA,
Massachusetts District, ss:

At a circuit court of the United States for the first circuit, begun and holden at Boston within and for the district of Massachusetts on Monday the sixteenth day of October, in the year of our Lord one thousand eight, hundred and seventy-six, the fifteenth day of said October happening on a Sunday.

Before the honorable George F. Shepley, circuit judge.

In equity.

THE SWAIN TURBINE AND MANUFACTURING Company, complainant,
v.
JAMES E. LADD, DEFENDANT.

1*b* The bill of complaint in this cause was filed in the clerk's office on the eleventh day of March, A. D. 1875, and was duly entered at the October term of this court, A. D. 1874, and is in the words and figures following, namely:

1*c* *Bill of complaint.*

SWAIN TURBINE AND MANUFACTURING Company,
vs.
JAMES E. LADD.

To the honorable the judges of the circuit court of the United States for the district of Massachusetts:

The Swain Turbine and Manufacturing Company, a corporation organized and existing under the laws of the commonwealth of Massachusetts, and having its usual place of business in Lowell, within said district of Massachusetts, brings this its bill of complaint against James E. Ladd, of Bristol, in the State of Connecticut, but occasionally and transiently commorant of Mill River, and other places within said district of Massachusetts.

1. And thereupon, your orator complains and on information and belief says that Asa M. Swain, of Chelmsford, in said commonwealth of Massachusetts, and at the time of the invention hereinafter set forth and ever since a citizen of the United States, was the original and first inventor of certain new and useful improvements in water-wheels, fully described in letters patent hereinafter mentioned, and which had not been known or used before his said invention, and which had not been in public use or on sale with his consent or allowance at or for more than two years prior to his application for a patent, as hereinafter set forth.

2*a* 2. That said Swain, on the fifteenth day of May, 1860, upon due application therefor, and upon complying in all respects with the laws of the United States and the regulations of the Patent Office in that behalf, obtained letters patent of the United States in due form of law for said invention and improvements under the seal of the Patent Office of the United States, signed by the Secretary of the Interior, and countersigned by the Commissioner of Patents of the United States,

bearing date on the fifteenth day of May, 1860, whereby there was granted and secured unto said Swain and his assigns, for the term of fourteen years from the date of said letters patent, the full and exclusive right of making, using, and vending to others to be used, the said invention and improvements, as set forth in said letters patent, as will more fully appear by said letters patent, now remaining of record in said Patent Office, and which, or a duly authenticated copy thereof, will be produced in court at the hearing of this bill of complaint.

3. That said Swain, by an instrument in writing, dated September 26, 1864, in due form, did sell, assign, and transfer one undivided half of said letters patent, together with one undivided half of the invention patented, to I. H. Jones, jr., and George W. Coombs, and their assigns, for the then unexpired term of said patent, which assignment was duly recorded in the Patent Office at Washington, as will more fully appear by said assignment, or a duly authenticated copy thereof, with the certificate of its having been so recorded in court to be produced.

4. That said I. H. Jones, jr., and said George W. Coombs, by an instrument in writing, duly executed, dated October 20, 1864, did sell and assign all their right, title, and interest in and to said letters patent and to said patented invention unto the Swain Turbine Company, a corporation established under the laws of the commonwealth of Massachusetts, for the then unexpired term of said patent, which assignment was duly recorded in said Patent Office, as will more fully appear by said assignment, or a duly authenticated copy thereof, with the certificate of its having been so recorded in court to be produced.

5. That said Swain, by an instrument in writing, duly executed and dated October 20, 1864, did sell and assign one undivided half
2*b* of said letters patent, together with one undivided half of said patented invention (being all his interest therein), for the then unexpired term of said patent unto the said Swain Turbine Company, which assignment was duly recorded in said Patent Office, as will more fully appear by said assignment, or a duly authenticated copy thereof, with the certificate of its having been so recorded in court to be produced.

6. That said I. H. Jones, jr., and said George W. Coombs, by an instrument in writing duly executed and dated the 1st of December, 1864, did sell and assign to the said Swain Turbine Company all their right, title, and interest in and to said letters patent and said patented invention for the then unexpired term of said patent and any extension thereof, which assignment was duly recorded in said Patent Office, as will more fully appear by said assignment, or by a duly authenticated copy thereof, with the certificate of its having been so recorded in court to be produced.

7. That the said Swain Turbine Company, while it was the sole owner of said letters patent and of said patented invention, having for good and lawful cause surrendered said letters patent to the Commissioner of Patents, and having made due application to said Commissioner for new letters patent for the same invention on an amended description and specification of said invention duly filed in said Patent Office, and having in all things complied with the acts of Congress and the regulations of said Patent Office in that behalf, did, on the nineteenth day of November, 1872, obtain new letters patent of the United States for the same invention, in an amended description and specification therefor, for the term of fourteen years from the date of said original patent, whereby there was granted to the Swain Turbine Company, its successors and assigns, for the term of fourteen years from the date of said original pat-

ent, the exclusive right of making, using, and vending to others to be used the said invention and improvements, as set forth in said new and reissued letters patent, as will more fully appear by a duly authenticated copy thereof (No. 5154) in court to be produced.

8. That said Swain having made due application to the said Commissioner of Patents, setting forth that he desired an extension of said
2c new letters patent, bearing date November 19, 1872, and the grounds thereof, and having fully complied with the law, and all the rules of the Patent Office in that behalf, did, on the 14th of May, 1874, obtain an extension of said new letters patent for the term of seven years from and after the expiration of said term of fourteen years for which said patent was originally granted, which said new letters patent were duly extended by said Commissioner of Patents, and a certificate of such extension dated the 14th of May, 1874, in due form under the seal of said Patent Office, and signed by said Commissioner of Patents, was duly annexed to said new letters patent, whereby there was granted to said Swain, his heirs and assigns, for the term of seven years from and after the expiration of said term of fourteen years for which said patent was originally granted, the full and exclusive right of making, using, and vending to others to be used the said invention and improvements as set forth in said new letters patent, as will more fully appear by said new letters patents with said certificate of extension annexed thereto, or a duly authenticated copy thereof in court to be produced.

9. That said Swain, by an instrument in writing duly executed dated the 22d of December, 1873, did sell and assign to said Swain Turbine Company all his right, title, and interest in and to said new letters patent, numbered 5154, together with all his right, title, and interest in and to the said patented invention, for and during the full term of any extension of said letters patent by the said Commissioner of Patents, which said instrument was duly recorded in said Patent Office, as will more fully appear by said instrument, or a duly authenticated copy thereof, with the certificate of its having been so recorded in court to be produced.

10. That the said Swain Turbine Company, by an instrument in writing duly executed, dated the second day of June, 1874, did sell and assign all its right, title, and interest in and to said new letters patent, dated November 19, 1872, and numbered 5154, as extended as aforesaid, with all its right, title, and interest in said patented invention, to your orator for and during the unexpired term of said new letters patent as extended for said seven years, which said instrument was duly recorded in said Patent Office, as will more fully appear by said instrument,
3a or a duly authenticated copy thereof, with a certificate of its having been so recorded in court to be produced.

11. And your orator further states that it is now the sole and exclusive owner of said invention and improvements, and of said new letters patent No. 5154, and of the extension thereof; that said invention is of great utility and value; that it has been used and enjoyed by the owners of said patent to their great benefit and advantage, and to the great benefit and advantage of the public; and that the public have generally acknowledged and acquiesced in the aforesaid rights of your orator under said patent. And your orator believes that it would continue to realize and receive large gains and profit from said patented invention, and that the public would continue to be greatly benefited thereby if infringements thereof by the defendant and his confederates should be prevented.

12. Yet the said defendant, well knowing the premises and the rights

acquired by and secured to your orator as aforesaid, but contriving to injure and deprive your orator of the benefits and advantages which might and otherwise would accrue to it from said patented invention, did, as your orator is informed and believes, during the years 1872, 1873, and 1874, and up to the date of this bill of complaint, but at what particular times your orator is unable to state, at Mill River and elsewhere in said district, and at various other places in the United States, without the license or permission and against the will of your orator, unlawfully and wrongfully, and in defiance of the aforesaid rights of your orator, and in infringement of said new letters patent No. 5154 and of the extension thereof, granted as aforesaid, use and employ the aforesaid invention and improvements, patented as aforesaid, and substantial and material parts thereof, in the manufacture, use and sale of water wheels; and did make, use, and vend to others to be used, said water wheels, made and operated according to and using and employing said invention and improvements, and substantial and material parts thereof, and did cause the same to be done, and still continues so to do.

And the defendant, as your orator is informed and believes, threatens to make, use, and sell to be used more of said water wheels, employing in their construction and operation said patented invention and
3*b* improvements, and substantial and material parts thereof, in infringement of said new letters patent and of the extension thereof, and in violation of the rights of your orator.

13. All of which doings of the defendant are in defiance of the rights acquired by and secured to your orator, as aforesaid, and tend to the great and irreparable loss and injury of your orator, and by which it has been and still is being deprived of great gains and profits which it might, and otherwise would, have obtained, but which have been received and enjoyed by the defendant through his said unlawful doings.

14. And your orator further states, on information and belief, that the defendant has realized large gains and profits from the use of said patented invention, and he prays for a discovery and restitution thereof.

15. Your orator further avers that the use of said patented invention by the defendant, and his avowed determination to continue his unlawful acts in defiance of the rights of your orator, have the effect to encourage and induce others to infringe said new letters patent, and the extension thereof, in disregard of your orator's rights under the same.

16. And your orator further states that the defendant has had notice of said infringement, and of the aforesaid rights of your orator, and has been requested to desist and to refrain from said infringements and from said unlawful acts, and to settle with and pay your orator therefor; but the defendant has disregarded said notice, and refused to desist from said unlawful acts and to settle with and pay your orator therefor. All of which is contrary to equity and good conscience.

17. To the end, therefore, that the said defendant may, if he can, show why your orator should not have the relief hereby prayed, and may, upon his oath, and according to his best and utmost knowledge, remembrance, information, or belief, full, true, direct, and perfect answer make to all and singular the matters hereinbefore stated and charged, as fully and particularly as if the same were here repeated, and he especially interrogated as to each and every of said matters; and that the defendant may be decreed to account for and pay over to your orator all gains and profits realized from said infringements, and all damages sus-
4*a* tained by your orator thereby; and that he may be restrained, with his servants, agents, and confederates, by an injunction, from making, using, or vending to others, any water wheels containing said

patented invention and improvements, or any substantial and material parts thereof, and for such other relief in the premises as may be equitable—

May it please your honors to grant to your orator a writ of subpœna in due form, commanding the defendant to appear and make answer to this bill of complaint, and to perform and abide by such order and decree herein as to this court may seem meet; and also to grant to your orator a writ of injunction conformable to the prayer of this bill, and also a provisional or preliminary injunction enjoining and restraining the defendant to the same purport and effect as hereinbefore prayed for in regard to said perpetual injunction.

SWAIN TURBINE AND MANUFACTURING COMPANY,
By A. F. NICHOLS, *Treasurer.*

JOHN S. ABBOTT,
Solicitor for Plaintiff.

DISTRICT OF MASSACHUSETTS,
City of Lowell, County of Middlesex, ss:

On this eighteenth day of February, 1875, personally appeared A. F. Nichols, treasurer of the said Swain Turbine and Manufacturing Company, and in behalf of said company made oath that the statements contained in the foregoing bill are true of his own knowledge, excepting as to the matters stated upon information and belief, and as to those matters he believes it to be true.

Before me.

[SEAL.] ABEL WHITNEY,
Notary Public.

4b This cause was thence continued to the May term of this court A. D. 1875, when, to wit, May 27, A. D. 1875, by consent, the following answer was filed, namely:

Answer of James E. Ladd.

The respondent now and at all times hereafter saving and reserving to himself all and all manner of benefit of exceptions which may be had or taken to the manifold errors, uncertainties, imperfections, and insufficiencies in the said bill of complaint contained, for answer thereto, or to so much thereof as he is advised it is material or necessary to make answer unto, answering, says:

That he is informed and believes, and therefore admits that letters patent of the United States bearing date the fifteenth day of May, 1860, for an alleged improvement in water wheels were granted to Asa M. Swain as the inventor thereof, but this respondent does not know and is not informed, otherwise than by said bill of complaint, whether or not said letters patent were obtained in due form of law, and leaves the complainant to make such proof thereof as it may be advised is requisite and material.

The respondent, further answering, says that he is not informed, save by said bill of complaint, whether or not said Swain sold and transferred one undivided half of said letters patent and invention to I. H. Jones, jr., and George W. Coombs, as alleged in said bill; nor whether or not said Jones and Coombs sold and assigned all their right, title, and interest to the Swain Turbine Company, as alleged in said bill; nor whether or not said Swain sold and assigned the remaining undivided half of said letters patent and invention to said Swain Turbine Com-

pany, as is alleged; nor whether or not said Jones and Coombs sold and assigned to said Swain Turbine Company all their right, title, and interest, as is further alleged in said bill of complaint; or whether or not said several alleged assignments were duly recorded, but the respondent leaves the complainant to make such proof thereof as it may be advised is requisite and material.

And the respondent, further answering, says that he is informed and believes, and therefore admits, that said letters patent were
5a surrendered and were reissued, bearing date the nineteenth day of November, 1872, but the respondent, upon information and belief, denies that said original letters patent were surrendered, or that said reissued letters patent were procured for any good or lawful purpose whatever, or that said reissued letters patent were obtained for the same invention for which the said original letters patent were granted; but that said reissued letters patent were procured with fraudulent and deceptive intentions, and particularly with the intent to cover and claim, as the invention of said Swain, more and other things than those which were described and shown in said original letters patent, or were included in said Swain's original invention; and this respondent avers that said reissued letters patent were, in fact, granted for more and other things and inventions than those which were described or shown in said original patent or in said original invention, so that this respondent denies that there was, by said reissue, legally granted said Swain Turbine Company, or its successors or assigns, any exclusive right to make, sell, and use the combinations and contrivances claimed in said reissued letters patent, as alleged in said bill of complaint.

The respondent further answering, on information and belief, admits that said Swain did obtain an extension of said reissued letters patent as alleged in said bill, but not being informed otherwise than by said bill, cannot say whether said extension was obtained upon full compliance with all the laws and rules as alleged; wherefore he leaves the complainant to make such proof thereof as it may be advised is requisite and material.

The respondent further answering says, that he does not know and is not informed, otherwise than by said bill, whether or not the said Swain assigned to the Swain Turbine Company, or whether or not said Swain Turbine Company assigned to the Swain Turbine and Manufacturing Company the title to said reissue and extension in manner and form as is alleged in said bill, but leaves the complainant to the proof of such assignments and of the recording of the same, and it may be advised is requisite and material.

The respondent further answering, upon information and belief, admits the utility of the combinations described and claimed in said reissued letters patent, but whether or not the same have been used
5b and enjoyed by the owners of said patent to the benefit and advantage of said owners and to the public the respondent is not informed and cannot aver, and therefore leaves the complainant to make such proof thereof as it may be able; but the respondent denies that the public have generally acknowledged and acquiesced in the alleged rights of the complainant under said reissue.

The respondent further answering upon information and belief, denies that said Swain was the original and first inventor of any of the several combinations and contrivances described in said reissued letters patent which the respondent is alleged to have infringed, but on the other hand avers that said alleged inventions, combinations and contrivances, and all substantial and material parts thereof, were, long prior to any sup-

posed invention thereof by said Swain, described in the following public works and letters patent, to wit: United States letters patent granted to Frederick Smith, Nov. 22, 1853; A. Greenleaf, May 16, 1854; Thomas Tripp, Feb. 20, 1855; John Tyler, May 27, 1855, July 8, 1856, and June 1, 1858; John Custer, May 25, 1858; A. M. Ford and C. W. Warner, Dec. 13, 1859; and John Temple, Feb. 8, 1859, Nos. 22,901 and 22,902.

The respondent further answering upon information and belief, avers that the several combinations and contrivances described in said reissued and extended letters patent, and all material and substantial parts thereof, were, long prior to any supposed invention thereof by the said Swain, known to and used by the following named persons, and at the several places hereinafter stated: Waldo Whitney and Martin W. Stratton, both of Leominster, Mass., at Manchester, N. H., and other places; Jotham Hartshorn, of Amherst, N. H., at Milford, N. H.; John L. Stow, of Newark, N. J., at Halifax and Hartland, Vt.; Sumner B. Small, of said Hartland, at said Hartland; Hiram Munger, of Chicopee Falls, at said Chicopee Falls and other places; William A. Crowell, of Salisbury, Conn., at said Salisbury and other places; William R. Richards, Samuel Taylor, both of Bristol, Conn., at said Bristol; Chester Heally, of New Hartford, Conn., at said New Hartford and other places.

The respondent further answering, says that he is informed and believes it to be true that the fifth claim of said reissued and extended letters patent is a claim for a result or function, and not for a
6a mechanical means or combination of co-operating parts for accomplishing a result or function, and the respondent submits that the said letters patent are on that account wholly inoperative and void.

The respondent further answering upon information and belief, avers that before the issue of said reissued letters patent, but whether before or after the date of said original letters patent the respondent is not informed and cannot say, the said Swain abandoned and dedicated to the public all those portions of his alleged inventions which form the subject matter of the first, second, third and fifth claims of said reissued and extended letters patent.

And the respondent further answering, denies that with the intention to injure the complainant or otherwise, he has at Mill River, or elsewhere in the district of Massachusetts, or anywhere in the United States used or employed the inventions and improvements patented to said Swain as alleged, or that he has made, used or sold water-wheels embodying said inventions or improvements, or any material parts thereof, or that he has threatened so to do; or that he has realized large gains or profits therefrom; or that any unlawful acts of the respondent tend to encourage others to infringe said extended letters patent; or that the defendant has done any act contrary to equity alleged in said bill.

And the respondent further answering, says that he has never been in any way connected use or sale of water-wheels, other than as a salaried superintendent of the National Water-Wheel Company, a corporation organized under the laws of the State of Connecticut, and located at Bristol, in said State and district; that he is not, and has not been, a director of said company, and has no voice in fact or law in determining in what business said company should engage; and the respondent therefore submits that he is not liable as an infringer, even though some of the wheels made by said company should be held to infringe the complainant's rights.

The respondent further answering, denies that the complainant is entitled to the relief, or any part thereof, in said complaint demanded; and this defendant prays the same advantage of this his aforesaid an-

swer as if he had pleaded or demurred to the said bill of complaint; and this defendant prays that he be dismissed with his reasonable costs and charges in this behalf most wrongfully sustained.

JAMES E. LADD.

STATE OF CONNECTICUT,
County of Hartford, ss:

BRISTOL, *May* 25, 1875.

Then personally came James E. Ladd, to me well known, and subscribed to the foregoing instrument in my presence, and made solemn oath before me to the truth of the same except as to those matters stated upon information and belief, to which he makes oath that he verily believes them to be true.

[L. S.] JAMES SHEPARD,
Notary Public.

6*b* On the second day of June, A. D. 1875, the following replication was filed, namely:

Replication.

This repliant saving and reserving unto itself all and all manner of advantage of exception to the insufficiencies of the defendant's answer, for replication thereunto saith that it will aver and prove its said bill to be true, certain and sufficient in the law to be answered unto, and that the said answer of the said defendant is uncertain, untrue and insufficient to be replied to by this repliant; without this, that any other matter or thing whatsoever in the said answer contained, material or effectual in the law to be replied unto, confessed and avoided, traversed or denied, is true; all which matters and things this repliant is and will be ready to aver and prove as this honorable court shall direct, and prays as in and by its said bill it hath already prayed.

JOHN S. ABBOTT,
Solicitor for Complainant.

This cause entered at the October term of this court, A. D. 1874, was thence continued from term to term of this court to the May term thereof, A. D. 1876, when the evidence taken in this cause, together with an agreement of parties accompanied by a printed copy of the bill of complaint, answer and evidence taken in the cause of this complainant v. William Huntley, was returned into court. Said agreement of parties is as follows:

7*a* *Agreement.*

Circuit court of the United States, district of Massachusetts.

SWAIN TURBINE AND MANUFACTURING COMPANY
v.
JAMES E. LADD. } In equity.

It is agreed for the purposes of this case that the stipulations, testimony, and exhibits taken and filed in the case of the same complainant against William Huntley, pending in said court (including the testimony

of Asa M. Swain, so far as taken), may be received and used at the hearing of the above case against said Ladd, except as hereinafter stated, with the same effect and subject to the same objections as though taken expressly in this case; and the printed testimony, etc., in the case against said Huntley is to be used with the same effect as if it had been printed in the case against said Ladd, except as hereinafter stated, striking out Huntley's name wherever it is referred to as defendant, and inserting instead thereof Ladd's name.

Complainant's closing testimony to be completed without unnecessary delay; and, as soon thereafter as conveniently practicable, the hearing is to be had in Boston or Portland, at whichever place the hearing can be first had.

If the complainant should prevail, no accounting is to be required in this case, and the bill against Ladd is to be amended so as to conform to the Huntley bill as to paragraph 16, and the next succeeding paragraph in the Huntley bill.

7*b* But the stipulation in the Huntley case, relating to "a contrivance described in letters patent granted to Waldo Whitney," is not to be included in the case against Ladd, and the following is substituted therefor:

It is also agreed that the letters patent No. 42,708, dated May 10, 1864, granted to Waldo Whitney, and introduced under objection in the Huntley case by defendant, shall be deemed as in the Ladd case without objection, and that said Whitney, as early as Aug. 1, 1856, made and reduced to practice a wheel, such as is described in said letters patent, and sold it to Jotham Hartshorn, of Amherst, N. H., and it was put into operation by him in a saw-mill in May, 1857, and so used till October, 1875, and large numbers of such wheels have been made and used. This wheel is now in plaintiff's possession at Lowell. The defendants may have reasonable opportunity to examine the wheel, and recall and examine their expert touching the wheel, before the plaintiffs take their rebuttal expert testimony.

Defendant's answer is also to be amended to conform to and render admissible all the testimony taken in said Huntley case, subject to the objections made while it was being taken, to any specific questions or answers; and said answer is to be considered as so amended. All taxable costs which might have been taxed in the Huntley case on account of the testimony stipulated above into the Ladd case are to be taxed in the Ladd case; and either party is to file a sufficient bond for cost upon notice from the other party, accompanied by a sufficient bond to the party so requested.

SWAIN TURBINE AND MANUFACTURING COMPANY,
By JOHN S. ABBOTT,
Solicitor.

JAMES E. LADD,
By MITCHELL & HUNGERFORD,
Solicitors.

8*a* The bill of complaint and answer in the cause of this complainant v. William Huntley, referred to in said agreement, are as follows:

Bill of complaint.—Filed February 23, 1875.

Circuit court of the United States, district of Massachusetts. In equity.

SWAIN TURBINE AND MANUFACTURING COMPANY
v.
WILLIAM HUNTLEY.

To the honorable the judges of the circuit court of the United States for the district of Massachusetts:

The Swain Turbine and Manufacturing Company, a corporation organized and existing under the laws of the Commonwealth of Massachusetts, and having its usual place of business in Lowell, within said district of Massachusetts, brings this, its bill of complaint, against William Huntley, of Mill River, within said district of Massachusetts:

1. And thereupon your orator complains, and, on information and belief, says that Asa M. Swain, of Chelmsford, in said Commonwealth of Massachusetts, and, at the time of the invention hereinafter set forth and ever since, a citizen of the United States, was the original and first inventor of certain new and useful improvements in water-wheels, fully described in letters patent hereinafter mentioned, and which had not been known or used before his said invention, and which had not been in public use or on sale with his consent or allowance, at or for more than two years prior to his application for a patent, as hereinafter set forth.

8*b* 2. That said Swain, on the fifteenth day of May, 1860, upon due application therefor, and upon complying, in all respects, with the laws of the United States, and the regulations of the Patent Office in that behalf, obtained letters patent of the United States in due form of law for said invention and improvements, under the seal of the Patent Office of the United States, signed by the Secretary of the Interior and countersigned by the Commissioner of Patents of the United States, bearing date on the fifteenth day of May, 1860, whereby there was granted and secured unto said Swain and his assigns for the term of fourteen years from the date of said letters patent the full and exclusive right of making, using, and vending to others to be used, the said invention and improvements, as set forth in said letters patent, as will more fully appear by said letters patent now remaining of record in said Patent Office, and which, or a duly authenticated copy thereof, will be produced in court at the hearing of this bill of complaint.

3. That said Swain, by an instrument in writing dated September 26, 1864, in due form, did sell, assign, and transfer one undivided half of said letters patent, together with one undivided half of the invention patented, to I. H. Jones, jr., and George W. Coombs, and their assigns, for the then unexpired term of said patent, which assignment was duly recorded in the Patent Office at Washington, as will more fully appear by said assignment, or a duly authenticated copy thereof, with the certificate of its having been so recorded, in court to be produced.

4. That said I. H. Jones, jr., and said George W. Coombs, by an instrument in writing duly executed, dated October 20, 1864, did sell and assign all their right, title, and interest in and to said letters patent, and to the said patented invention, unto the Swain Turbine Company, a corporation established under the laws of the Commonwealth of Massachusetts, for the then unexpired term of said patent, which assignment was duly recorded in said Patent Office, as will more fully appear

by said assignment, or a duly authenticated copy thereof, with the certificate of its having been so recorded, in court to be produced.

5. That said Swain, by an instrument in writing duly executed and dated October 20, 1864, did sell and assign one undivided half
9a of said letters patent, together with one undivided half of said patented invention (being all his interest therein), for the then unexpired term of said patent, unto the said Swain Turbine Company, which assignment was duly recorded in said Patent Office, as will more fully appear by said assignment, or a duly authenticated copy thereof, with the certificate of its having been so recorded, in court to be produced.

6. That said I. H. Jones, jr., and said George W. Coombs, by an instrument in writing duly executed and dated the first of December, 1864, did sell and assign to the said Swain Turbine Company, all their right, title and interest in and to said letters patent, and said patented invention, for the then unexpired term of said patent and any extension thereof, which assignment was duly recorded in said Patent Office, as will more fully appear by said assignment, or by a duly authenticated copy thereof, with the certificate of its having been so recorded, in court to be produced.

7. That the said Swain Turbine Company, while it was the sole owner of said letters patent and of said patented invention, having for good and lawful cause surrendered said letters patent to the Commissioner of Patents, and having made due application to said Commissioner for new letters patent for the same invention on an amended description and specification of said invention, duly filed in said Patent Office, and having in all things complied with the acts of Congress and the regulations of said Patent Office in that behalf, did on the nineteenth of November, 1872, obtain new letters patent of the United States for the same invention on an amended description and specification thereof, for the term of fourteen years from the date of said original patent. Whereby there was granted to the said Swain Turbine Company, its successors and assigns, for the term of fourteen years from the date of said original patent, the exclusive right of making, using, and vending to others to be used, the said invention and improvements, as set forth in said new and reissued letters patent, as will more fully appear by a duly authenticated copy thereof (No. 5,154), in court to be produced.

8. That said Swain, having made due application to the said Commissioner of Patents, setting forth that he desired an extension of said new letters patent, bearing date November 19, 1872, and the
9b grounds thereof, and having fully complied with the law and all the rules of the Patent Office, in that behalf, did, on the fourteenth of May, 1874, obtain an extension of said new letters patent, for the term of seven years from and after the expiration of said term of fourteen years, for which said patent was originally granted; which said new letters patent were duly extended by said Commissioner of Patents, and a certificate of such extension dated the fourteenth of May, 1874, in due form, under the seal of said Patent Office, and signed by said Commissioner of Patents, was duly annexed to said new letters patent. Whereby there was granted to said Swain, his heirs and assigns, for the term of seven years from and after the expiration of said term of fourteen years, for which said patent was originally granted, the full and exclusive right of making, using, and vending to others to be used, the said invention and improvements as set forth in said new letters patent, with said certificate of extension annexed thereto, or a duly authenticated copy thereof, in court to be produced.

9. That said Swain, by an instrument in writing, duly executed, dated the twenty-second day of December, 1873, did sell and assign to the said Swain Turbine Company all his right, title, and interest in and to said new letters patent No. 5,154, together with all his right, title, and interest in and to the said patented invention, for and during the full term of any extension of said letters patent by the said Commissioner of Patents, which said instrument was duly recorded in said Patent Office, as will fully appear by said instrument, or a duly authenticated copy thereof, with a certificate of its having been so recorded, in court to be produced.

10. That the said Swain Turbine Company, by an instrument in writing, duly executed, dated the second day of June, 1874, did sell and assign all its right, title, and interest in and to said new letters patent, dated November 19, 1872, and numbered 5,154, as extended as aforesaid, with all its right, title, and interest in the said patented invention, to your orator for and during the unexpired term of said new letters patent, as extended, for said seven years, which said instrument was duly recorded in said Patent Office, as will more fully appear by said
10*a* instrument, or a duly authenticated copy thereof, with the certificate of its having been so recorded, in court to be produced.

11. And your orator further states that it is now the sole and exclusive owner of said invention and improvements, and of said new letters patent, No. 5154, and of the extension thereof; that said invention is of great utility and value; that it has been used and enjoyed by the owners of said patent to their great benefit and advantage, and to the great benefit and advantage of the public, and that the public have generally acknowledged and acquiesced in the aforesaid rights of your orator under said patent, and your orator believes that it would continue to realize and receive large gains and profits from said patented invention, and that the public would continue to be greatly benefited thereby if infringements thereof by the defendant and his confederates should be prevented.

12. Yet the said defendant, well knowing the premises and the rights acquired by and secured to your orator as aforesaid, but contriving to injure and deprive your orator of the benefits and advantages which might and otherwise would accrue to it from said patented invention, did, as your orator is informed and believes, during the years 1872, 1873, and 1874, and up to the date of this bill of complaint, but at what particular times your orator is unable to state, at Mill River and elsewhere in said district, and at various other places in the United States, without the license or permission and against the will of your orator, unlawfully and wrongfully and in defiance of the aforesaid rights of your orator, and in infringement of said letters patent, No. 5,154, and of the extension thereof, granted as aforesaid, use and employ, and caused to be used and employed the aforesaid invention and improvements patented as aforesaid, and substantial and material parts thereof in the manufacture, use, and sale of water wheels, and did make, use, and vend, and did cause to be made, used, and vended to others to be used said water wheels, made and operated according to, and using and employing said invention and improvements, and substantial and material parts thereof, and did cause the same to be done and still continues so to do. And the defendant, as your orator is informed and believes,
10*b* threatens to make, use, and sell, to be used, more of said water wheels, employing in their construction and operation and patented invention and improvements, and substantial and material parts

thereof, in infringement of said new letters patent and of the extension thereof, and in violation of the rights of your orator.

13. All of which doings of the defendant are in defiance of the rights acquired by and secured to your orator as aforesaid, and tend to the great and irreparable loss and injury of your orator, and by which it has been and still is being deprived of great gains and profits which it might and otherwise would have obtained, but which have been received and enjoyed by the defendant through his said unlawful doings.

14. Your orator further avers that the use of said patented invention by the defendant, and his avowed determination to continue his unlawful acts in defiance of the right of your orator, have the effect to encourage and induce others to infringe said new letters patent and the extension thereof, in disregard of your orator's rights under the same.

15. And your orator further states that the defendant has had notice of said infringement and of the aforesaid rights of your orator, and has been requested to desist and to refrain from said infringement and from said unlawful acts, and the defendant does not comply with said notice and request, but the defendant has disregarded said notice and refuses to desist from said unlawful acts, and to settle with and pay your orator therefor, all of which is contrary to equity and good conscience.

16. To the end, therefore, that the said defendant may, if he can, show why your orator should not have the relief hereby prayed, and may upon his oath, and according to his best and utmost knowledge, remembrance, information or belief, full, true, direct, and perfect answer make to all and singular the matters hereinbefore stated and charged as fully and particularly as if the same were here repeated, and he especially interrogated as to each and every of said matters, and that the defendant may be restrained, with his servants, agents, and confederates, by an injunction from making, using, or vending to others any water wheels containing said patented invention and improvements, or any substantial and material parts thereof.

11*a* The complainant does not waive its claim against the defendant and his agents, employés and confederates for damages and profits on account of said unlawful acts, but will insist on the same by appropriate legal proceedings, unless just compensation should be voluntarily made.

May it please your honors to grant to your orator a writ of subpœna, in due form, commanding the defendant to appear and make answer to this bill of complaint, and to perform and abide by such order and decree therein as to this court may seem meet, and also to grant to your orator a writ of injunction conformable to the prayer of this bill, and also a preliminary or provisional injunction enjoining and restraining the defendant to the same purport and effect as hereinbefore prayed for in regard to said perpetual injunction.

SWAIN TURBINE AND MANUFACTURING COMPANY,
ALBERT F. NICHOLS, *Treasurer.*

JOHN S. ABBOTT,
Solicitor for Complainant.

DISTRICT OF MASSACHUSETTS,
City of Lowell, County of Middlesex, ss:

On this fifth day of March, 1875, personally appeared Albert F. Nichols, treasurer of said Swain Turbine and Manufacturing Company, and in behalf of said company made oath that the statements contained in the foregoing bill are true of his own knowledge, excepting as to mat-

ters stated upon information and belief, and as to those matters he believes it to be true.

Before me.

[SEAL.] CHAS. F. HOWE,
Notary Public.

11*b* *Answer of William Huntley.—Filed May* 31, 1875.

The answer of the respondent to the bill of complaint of the Swain Turbine and Manufacturing Company.

The respondent, now and at all times hereafter saving and reserving to himself all and all manner of benefit of exceptions which may be had or taken to the manifold errors, uncertainties, imperfections, and insufficiencies in the said bill of complaint contained, for answer thereto or to so much thereof as he is advised it is material or necessary to make answer unto, answering, says:

That he is informed and believes, and therefore admits, that letters patent of the United States bearing date the fifteenth day of May, 1860, for an alleged improvement in water wheels, were granted to Asa M. Swain as the inventor thereof, but this respondent does not know and is not informed, otherwise than by said bill of complaint, whether or not said letters patent were obtained in due form of law, and leaves the complainant to make such proof thereof as it may be advised is requisite and material.

The respondent, further answering, says that he is not informed, save by said bill of complaint, whether or not said Swain sold and transferred one undivided half of said letters patent and invention to I. H. Jones, jr., and George W. Coombs, as alleged in said bill; nor whether or not said Jones and Coombs sold and assigned all their right, title, and interest to the Swain Turbine Company as alleged in said bill; nor whether or not said Swain sold and assigned the remaining undivided half of said letters patent and invention to said Swain Turbine Company as is alleged; nor whether or not said Jones and Coombs sold and assigned to said Swain Turbine Company all their right, title, and interest as is further alleged in said bill of complaint; or whether or not said several alleged assignments were duly recorded, but the respondent leaves the complainant to make such proof thereof as it may be advised is requisite and material.

And the respondent, further answering, says that he is informed and believes, and therefore admits, that said letters patent were
12*a* surrendered and were reissued, bearing date the nineteenth day of November, 1872, but the respondent, upon information and belief, denies that said original letters patent were surrendered, or that said reissued letters patent were procured, for any good or lawful purpose whatever, or that said reissued letters patent were obtained for the same invention for which the said original letters patent were granted; but that said reissued letters patent were procured with fraudulent and deceptive intentions, and particularly with the intent to cover and claim, as the invention of said Swain, more and other things than those which were described and shown in said original letters patent or were included in said Swain's original invention; and this respondent avers that said reissued letters patent were, in fact, granted for more and other things and inventions than those which were described or shown in said original patent or in said original invention, so that this respondent denies that there was, by said reissue, legally granted said Swain

Turbine Company, or its successors or assigns, any exclusive right to make, sell, and use the combinations and contrivances claimed in said reissued letters patent, as alleged in said bill of complaint.

The respondent, further answering, on information and belief, admits that said Swain did obtain an extension of said reissued letters patent as alleged in said bill, but not being informed otherwise than by said bill, cannot say whether said extension was obtained upon full compliance with all the laws and rules as alleged; wherefore he leaves the complainant to make such proof thereof as it may be advised is requisite and material.

The respondent, further answering, says that he does not know and is not informed, otherwise than by said bill, whether or not the said Swain assigned to the Swain Turbine Company, or whether or not said Swain Turbine Company assigned to the Swain Turbine and Manufacturing Company the title to said reissue and extension in manner and form as is alleged in said bill, but leaves the complainant to the proof of such assignments and of the recording of the same, and he may be advised is requisite and material.

The respondent, further answering, upon information and belief, admits the utility of the combinations described and claimed in said reissued letters patent, but whether or not the same have been used
12b and enjoyed by the owners of said patent to the benefit and advantage of said owners and to the public, the respondent is not informed and cannot aver, and therefore leaves the complainant to make such proof thereof as it may be able; but the respondent denies that the public have generally acknowledged and aequiesced in the alleged rights of the complainant under said reissue.

The respondent, further answering, on information and belief, denies that said Swain was the original and first inventor of any of the several combinations and contrivances described in said reissued letters patent which the respondent is alleged to have infringed, but on the other hand avers that said alleged inventions, combinations, and contrivances, and all substantial and material parts thereof, were, long prior to any supposed invention thereof by said Swain, described in the following public works and letters patent, to wit, United States Letters Patent granted to Frederick Smith, Nov. 22, 1853; A. Greenleaf, May 16, 1854; Thomas Tripp, Feb. 20, 1855; John Tyler, May 27, 1855, July 8, 1856, and June 1, 1858; John Custer, May 25, 1858; A. M. Ford and C. W. Warner, Dec. 13, 1859; and John Temple, Feb. 8, 1859, Nos. 22901 and 22902.

The respondent, further answering, upon information and belief, avers that the several combinations and contrivances described in said reissued and extended letters patent, and all material and substantial parts thereof, were, long prior to any supposed invention thereof by the said Swain, known to and used by the following named persons, and at the several places hereinafter stated: Waldo Whitney and Martin W. Stratton, both of Leominster, Mass., at Manchester, N. H., and other places; Jotham Hartshorn, of Amherst, N. H., at Milford, N. H.; John L. Stow, of Newark, N. J., at Halifax and Hartland, Vt.; Sumner B. Small, of said Hartland, at said Hartland; Hiram Munger, of Chicopee Falls, at said Chicopee Falls and other places; William A. Crowell, of Salisbury, Conn., at said Salisbury and other places; William R. Richards, Samuel Taylor, both of Bristol, Conn., at said Bristol; Heally, of New Hartford, Conn., at said New Hartford and other places.

The respondent, further answering, says that he is informed and be-

lieves it to be true that the fifth claim of said reissued and extended letters patent is a claim for a result or function, and not for a
13a mechanical means or combination of co-operating parts for accomplishing a result or function, and the respondent submits that the said reissued letters patent are on that account wholly inoperative and void.

The respondent, further answering, upon information and belief avers that before the issue of said reissued letters patent, but whether before or after the date of said original letters patent the respondent is not informed and cannot say, the said Swain abandoned and dedicated to the public all those portions of his alleged inventions which form the subject matter of the first, second, third and fifth claims of said reissued and extended letters patent.

The respondent, further answering, denies that with the intention to injure the complainant, or otherwise, he has at Mill River, or elsewhere in the district of Massachusetts, or anywhere in the United States used or employed the inventions and improvements patented to said Swain as alleged, or that he has made, used or sold water wheels embodying said inventions or improvements, or any material parts thereof, or that he has threatened so to do; or that he has realized large gains or profits therefrom; or that any unlawful acts of the respondent tend to encourage others to infringe said extended letters patent; or that the defendant has done any other act contrary to equity alleged in said bill.

The respondent, further answering, denies that the said complainant is entitled to the relief, or any part thereof, in said complaint demanded; and this defendant prays the same advantage of this his aforesaid answer as if he had pleaded or demurred to the said bill of complaint; and this defendant prays that he be dismissed with his reasonable costs and charges in this behalf most wrongfully sustained.

WILLIAM HUNTLEY.

COMMONWEALTH OF MASSACHUSETTS,
Berkshire, ss:

MAY 27, 1875.

Then the above-named William Huntley made oath to the foregoing answer by him subscribed.

Before me,

[SEAL] F. N. DELAND,
Notary Public.

13b At the May term of this court, A. D. 1876, publication of th evidence passed in the clerk's office, and this cause was set down for hearing and fully heard by the court, pursuant to the agreement of parties in this cause, and thence this cause was continued to this present term, when, to wit, January 2, 1877, the opinion of this court in this cause is read: It is thereupon ordered, adjudged and decreed by the court that the bill of complaint in this cause be, and the same is hereby, dismissed with costs to the said James E. Ladd, defendant, taxed at * * * * *

From this decree the said complainant, in open court, claims an appeal to the Supreme Court of the United States, and gives good and sufficient security to prosecute its said appeal to effect, and answer all damages and costs if it fails to make its plea good, which said security being approved by the court said appeal is allowed accordingly.

Attest: JOHN G. STETSON, *Clerk.*

A true record.

14*a* The following is the evidence used at the hearing of this cause before this circuit court pursuant to the agreement of parties relating thereto, namely:

EVIDENCE FOR COMPLAINANT.

Taken pursuant to the sixty-seventh rule of the Supreme Court of the United States in equity, as amended before me.

JOHN G. STETSON, *Examiner.*

BOSTON, *June* 23, 1875.

Present: John S. Abbott, esq., and H. W. Boardman, esq., of counsel for complainant; Causten Browne, esq., and Charles E. Mitchell, esq., of counsel for defendant.

Before me,

JOHN G. STETSON,
Examiner.

It is agreed for the purposes of this case that the defendant, William Huntley, in the month of November last, sold in the district of Massachusetts thirty-inch water wheels, and forty-inch water wheels, made by the National Water Wheel Company, of Bristol, Conn., from the same patterns as the two wheels named below, and identical with said two wheels, one of said two wheels being a thirty-inch wheel, and the other a forty-inch wheel, made by said company, and sent last year by the company to Brunswick, Me., at request of Dennison & Brown, of Portland, Me., or of one of said firm, the thirty-inch wheel being now in said Brunswick, but not in use, and the forty-inch wheel being in use in a paper mill of said Dennison & Brown, in said Brunswick. The said thirty-inch wheel at Brunswick, or a similar one from the works of said National Water Wheel Company, is to be forthwith sent by defendant to the examiner to be used by complainant as an exhibit, expenses of sending to be paid by complainant, and defendant to have the right to withdraw the same at any time, first giving complainant an opportunity to prepare and file an accurate model thereof as a substitute, or
14*b* at request of complainant the defendant is to make and file such model at expense of complainant.

*It is further agreed as above that the contrivance described in letters patent of the United States, No. 42708, dated May 10, 1864, granted to Waldo Whitney, for an improvement in water wheels, dates back to August 1, 1856, the first wheel made in accordance with said description having been made and reduced to practice by said Whitney as early as said August 1, 1856.

Counsel for complainant put in evidence certified copy of letters patent of the United States, No. 28314, granted A. M. Swain, May 15, 1860, for improvement in water wheels, and the same is marked Exhibit A, J. G. S., examiner.

Counsel for complainant also put in evidence certified copy of reissued letters patent of the United States, No. 5154, granted the Swain *Tribune* Company, assignee of Asa M. Swain, November 19, 1872, for improvement in water wheels, and the certificate of the extension of

* This stipulation is not included in the case against Ladd, another being substituted therefor. See agreement, page 7*b*, first and second paragraphs.

said reissued letters patent, and the same is marked Exhibit B, J. G. S., examiner.

Counsel for complainant also put in evidence certified copy of the following assignments:

1. Asa M. Swain to I. H. Jones, jr., and George W. Coombs, dated September 26, 1864;

2. I. H. Jones, jr., and George W. Coombs to the Swain Turbine Company, dated October 20, 1864;

3. A. M. Swain to the Swain Turbine Company, dated October 20, 1864;

4. I. H. Jones, jr., and George W. Coombs to the Swain Turbine Company, dated December 1, 1864;

5. A. M. Swain to the Swain Turbine Company, dated December 22, 1873;

6. The Swain Turbine Company to the Swain Turbine and Manufacturing Company, dated June 2, 1874; and the same is marked Exhibit C, J. G. S., examiner.

(The above certified copies of assignments are put in evidence subject to the following objections on the part of defendant, to wit:

1st. For want of proof of the execution of each of said instruments by the parties thereto.

15 2d. For want of proof of the power of H. W. Boardman, attorney and agent, to execute on behalf of the Swain Turbine Company the assignments of December 22, 1873, and June 2, 1874.

3d. For want of proof of the corporate organization of the Swain Turbine Company and the Swain Turbine and Manufacturing Company.

4th. For want of production of the memorandum of agreement dated June 2, 1874, named in the said assignment of that date.

And the defendant gives notice that he will insist upon the exhibition by the complainant of legal proof upon each of these points.)

Attest:

JOHN G. STETSON,
Examiner.

Exhibit A, J. G. S., examiner.

Letters patent of the United States, No. 28314. Granted A. M. Swain, May 15, 1860. Improvement in water wheels.

The schedule referred to in these letters patent and making part of the same.

To all whom it may concern:

Be it known that I, A. M. Swain, of Lowell, in the county of Middlesex, and State of Massachusetts, have invented a new and improved water wheel; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the annexed drawings, making a part of this specification, in which

Figure 1 is a vertical section of my invention, taken in the line *x*, *x*, Fig. 3.

Figure 2 is a detached view of the wheel.

Figure 3 is a horizontal section of ditto taken in the line *y*, *y*, Fig. 1.

16 Similar letters of reference indicate corresponding parts in the several figures.

The object of this invention is to obtain a simple and efficient hor-

izontal water-wheel, one that will have all its parts accessible for repairs, and which will give the maximum power of varying heads with an economical use of the water.

A represents a cast iron case, which encloses the wheel and the parts pertaining thereto. This case is of scroll form, as shown clearly in Figure 3, and it is supported by standards *a* and a curb, B, which are cast with a bell-shaped base, C, as shown clearly in Figure 1. In the top of the bell-shaped base C there is placed an iron block, D, which forms a step to receive a wooden block, E, that is fitted in the lower end of the hub F of the wheel G. Transversely through the hub F and block E a bar, *b*, passes, said bar having screws *c* bearing on it, one near each end. These screws *c* pass up through the centre or hub of the wheel, and, by adjusting them, the wheel may be raised or lowered, as desired, with the greatest facility, without removing the wheel from its proper working position, and without being troubled with the influence or action of water.

The wheel G has its floats *d* cast or constructed each of a single piece of metal. The face sides of the floats *d*, where the water impinges, are of a paraboloidal form, whose axes are tangent to a circle to which the guides *e*, hereinafter described, are also tangents, and also to the curve at or near the outer circumference of the wheel. The bottoms of the floats are formed by revolving the curves on their axes.

Into the top of the case A a curb, H, is fitted. To the bottom of this curb there is attached an annular chamber, I, which may be termed a hydrostatic chamber.

The bottom of this chamber is slotted to receive the guides *e* previously mentioned. These guides are plates attached to or cast with a ring or cylinder, J. Three of the guides *e* are enlarged to allow rods *f* to pass through, and the upper parts of said rods have screws, *g*, formed on them, said screws passing through a flanch, *h*, at the inner side and bottom of curb H. Each screw *g* has a nut, *h'*, on it,
17 said nuts being pinions into which a spur wheel, I', gears, the wheel I' being concentric with the shaft K of the wheel and having a pinion, *a**, gearing into it, the pinion being on a shaft, *b**, which is surmounted by a hand-wheel.

The chamber I is made tight with the exception of the slots for the reception of the guides *e*, previously described; the water entering and forming a complete stuffing-box, by means of which I obtain adjustable, tapering chutes, formed by the bottom of chamber I, guides *e*, and the top of cylinder J. The ring or cylinder J encompasses the top of the lower curb B, the lower part of the cylinder being provided with packing, *i*, which is secured to the bottom of the cylinder by a ring, *j*. From the above description it will be seen that by turning the shaft *b** the wheel G and pinions *h'* will be turned simultaneously, and the guides *e* raised or lowered as desired. These guides *e*, in connection with the lower and upper surfaces of I, J, as previously stated, form chutes which direct the water properly to the buckets, and by raising and lowering them, the volume of water admitted to the wheel may be increased or diminished at will, and the capacity of the wheel regulated as occasion may require.

These adjustable chutes also form a gate by which the water may be entirely cut off from the wheel. The floats *d* may occupy one-third the radius of the wheel, and have a depth of three-sixths of the same; the width of space occupied by the guides *e* may be the same as the floats. The sum of the shortest distance between the guides may be

nine-fifths the diameter of the wheel. This, together with the number of guides, determines the narrowest section of each guide, and also the angle at which the water strikes the float, and also determines in a measure the paraboloidal curves of the floats. The inner and lower edge of the chamber I and upper edge of the ring or cylinder J are turned true, so that when J is drawn up it will make a complete water-tight joint and keep all water from the wheel. When J is lowered the water strikes the floats with all the force and velocity due to its head, directly under the rim of the wheel, which is so curved as to force the water down rapidly in the lower curved parts or bottoms of the floats, the water not leaving the wheel until its force has been properly expended
18 on it. The water is discharged down between the curb and wheel and lower curb H, and is turned outward by the base *c*.

The particular angle which the guides *e* have in relation to each other is the same as that which the bottom of the chamber I and the bottom of the cylinder J bear to each other, to wit, about 13½°, and not more than 150. Whatever the size of the wheel may be, no less than twenty-four guides and not more than twenty-seven are used. The number of floats used will depend on the size of the wheel, but never less than twenty-three and not more than four inches apart for a wheel of any diameter.

The advantages possessed by this wheel over others of a similar class are: 1. The wheel has not that great weight of water bearing on it to wear the step away. 2. The wheel may be readily raised without removing it from its proper working position. 3. All parts are very accessible for repairs, and removable at pleasure. 4. It is lighter than the majority of wheels and may be started with less water, and run up to speed with far less water than is required by scroll wheels.

Having thus described my invention, what I claim as new, and desire to secure by letters patent, is—

First. The annular chamber I, arranged substantially as shown, and provided with slots to receive the guides *e* when the latter are attached to the cylinder J, for the purpose set forth.

Second. The arrangement of the guides *e* and cylinders J attached to curb B and chamber I, forming the gate, when said parts are arranged in relation with the wheel G substantially as and for the purpose specified.

Third. The adjusting of the block E by means of the bar *b* and set screws *c*, for the purpose of adjusting the wheels to compensate for the wear of the step.

A. M. SWAIN.

Witnesses:
S. C. PRATT.
S. PEARSON.
JOHN NESMITH.

19 EXHIBIT B.

Exhibit B, J. G. S., Examiner.

Letters patent of the United States. Reissue No. 5154. Asa M. Swain, of Lowell, Massachusetts, assignor by mesne assignments to the Swain Turbine Company, of same place. Improvement in water wheels.

Specification forming part of letters patent No. 28314, dated May 15, 1860. Reissue No. 5154, dated November 19, 1872.

To all whom it may concern:

Be it known that Asa M. Swain, of Lowell, Massachusetts, has in-

vented certain improvements in water wheels, of which the following is a specification:

This invention relates particularly to the improved construction, combination, and arrangement of the different parts of a water wheel in such a manner as to effectively combine in one wheel the elements of an inward-flow turbine and a downward-flow turbine, together with an effective direction of the water at any opening of the gate, giving increased capacity, compactness, efficiency, and economy to the wheel.

Figure 1 is a vertical section on a line, *x x*; Fig. 3, sheet 2, of a wheel embodying this invention; Fig. 2, sheet 1, is a side view of the wheel with a portion of the band broken away and showing the floats; and Fig. 3, sheet 2, is a horizontal section on a line, *y y*, Fig. 1, sheet 1, of a wheel embodying this invention.

A is an outer case surrounding the wheel, through which the water passes to the wheel. B is a lower curb, on the outer flange of which rests the case A. This curb has a sediment-chamber, L. The upper portion forms a bearing and guide for the cylindrical gate J and its packing, *i i*. This curb is supported by the standards *a a*, Fig. 1, sheet 1, which rest on the outer edge of the bell-shaped base C. In
20 t op of the base C is placed an iron block, D, which forms a step to receive the wooden block E, which is fitted in the lower end of the hub F of the wheel G. Transversely through the hub F and block E a bar, *b*, passes, said bar having screws, *c c*, bearing on it, one near each end. These screws *c c* pass up through the hub of the wheel, and by adjusting them the wheel may be raised or lowered, as desired. The shaft K is attached to the hub F of the wheel G. To the crown of the wheel G are attached the floats *d*. P is a band which may be attached to the lower outer edges of the floats to give greater rigidity. The upper horizontal edge of the floats is attached to the crown of the wheel, and the outer lower edge may be attached to a band. The surface of the floats may be curved in a horizontal direction at their upper portion and have a curve of double curvature at their lower portion.

By this construction of the arrangement of the crown and floats we combine an inward-flow turbine and a downward-flow turbine effectively in one wheel, which gives greater area of discharge nearer the centre of the wheel, the floats having a discharge-line equal to the height of the float in the well-known Fourneyrou or Warren wheels, and that due to the width of the float in a radial direction, as in the Jouval turbine.

J is a cylindrical gate fitted around the upper portion of the curb B, and packed against the curb at *i i* with leather or other suitable packing. M is a disk attached to the gate J, over which the water flows to the wheel G. N is also a disk attached to the lower edge of the upper curb H, under which the water passes to the wheel. These disks facilitate and direct the passage of the water to the wheel. Guides *e e* are attached to the gate-disk M, and pass through slots in the upper disk N. This arrangement permits the gate to be opened and closed, while the guides at all times extend from one disk to the other. The gate J is closed by raising it to meet the lower edge of the curb H, these edges being fitted to form a water-tight joint. By this arrangement the water is, at part gate as well at full gate, conducted onto the upper portion of the floats of the wheel, when it acts with the greatest efficiency, obviating almost wholly the objections incident to other turbines at part gate.

The gate is operated by means of the screws *f f* attached to the gate-disk M, and working in gear-nuts *h h*, moved by the gear I',
21 engaging all the gear-nuts, and operated by the pinion *a** and hand-

whee *o*. Attached to the case A is the curb H, which, with the gate J and its packing *i i*, prevents the water from flowing away except through the wheel.

We claim as the invention of the said Asa M. Swain the following, to wit:

1. A water-wheel, the floats of which have a discharge-line extending from the crown at their inner edge to the lower outer edge of the wheel.

2. The combination in a water-wheel of a crown, band, and floats, having their discharge-line extending from the crown at their inner edge to their lower outer edge.

3. The combination in a water-wheel of a crown and floats having their discharge-line extending from the crown at their inner edge to the lower outer edge.

4. The combination of the screws *c c*, bar *b*, and block E, for the purpose specified.

5. A water-wheel having an effective inward flow and discharge of part of the water and an effective downward flow and discharge of part of the water simultaneously in one wheel, whereby the effective area of discharge is increased without increasing the diameter of the wheel.

6. The gate J attached to disk M, as shown and described.

7. The gate J with its disk M, combined with the disk *h*, for the purposes shown and stated.

8. The gate J with its disk M and disk N, in combination with the guides *e*, as shown and described.

9. The combination and arrangement of a gate, J, with reference to the wheel G and curb H, for the purposes specified.

10. A water-wheel having the gate opening downward, for the purposes specified.

11. The chamber L, for receiving sediment, as shown and described.

SWAIN TURBINE COMPANY,
By H. W. BOARDMAN,
Agent and Attorney.

Witnesses:
JOHN B. MOTLEY.
NATHANIEL HILL.

22 CERTIFICATE OF EXTENSION.

Whereas, upon the petition of Asa M. Swain, of North Chelmsford, Massachusetts, for the extension of the patent granted to him May 15, 1860, and reissued November 19, 1872, for an "improvement in water wheels," the undersigned, in accordance with the act of Congress approved the eighth day of July, 1870, entitled "An act to revise, consolidate, and amend the statutes relating to patents and copyrights," did, on this fourteenth day of May, 1874, decide that said patents ought to be extended:

Now, therefore, I, Mortimer D. Leggett, Commissioner of Patents, by virtue of the power vested in me by said act of Congress, do renew and extend the said patent, and certify that the same is hereby extended for the term of seven years from and after the expiration of the first term, viz, from the fifteenth day of May, 1874, which certificate being duly entered of record in the Patent Office, the said patent has now the same effect in law as though the same had been originally granted for the term of twenty-one years.

In testimony whereof I have caused the seal of the Patent Office to be

hereunto affixed this fourteenth day of May, 1874, and of the Independence of the United States the ninety-eighth.

[L. S.] M. D. LEGGETT,
Commissioner.

Exhibit C, J. G. S., Examiner.

THE UNITED STATES PATENT OFFICE.

To all persons to whom these presents shall come, greeting:

This is to certify that the annexed is a true copy from the records of this office of assignments recorded in liber P^7, page 26; K^7, page 405 and 406; O^7, page 200; V^{17}, page 341, and V^{18}, page 404, of transfers of patents.

In testimony whereof I, Ellis Spear, Acting Commissioner of Patents, have caused the seal of the Patent Office to be hereunto affixed
23 this eighth day of June, in the year of our Lord one thousand eight hundred and seventy-five, and of the Independence of the United States the ninety-ninth.

[L. S.] ELLIS SPEAR,
Acting Commissioner.

(1) Liber P^7, page 26.

Whereas I, A. M. Swain, of North Chelmsford, in the county of Middlesex, and commonwealth of Massachusetts, formerly of Lowell, in said county, did obtain letters patent of the United States for certain improvements in water wheels, which letters patent bear date of the fifteenth day of May, A. D. eighteen hundred and sixty;

And whereas I. H. Jones, junior, of Boston, in the county of Suffolk, and George W. Coombs, of Wrentham, in the county of Norfolk, both in said commonwealth, are desirous of acquiring an interest therein:

Now, this indenture witnesseth, that for and in consideration of the sum of four thousand dollars to me paid, the receipt of which is hereby acknowledged, I have assigned, sold and set over, and do by these presents assign, sell and set over unto said Jones and Coombs one undivided half part of all the right, title and interest in and to said invention as secured by said letters patent.

The same to be held and enjoyed by said Jones and Coombs for their own use and behoof, and for the use and behoof of their legal representatives and assigns, to the full end of the term for which said letters patent are or may be granted or extended as fully and entirely as the same would have been held and enjoyed by me had this assignment and sale not been made.

In witness whereof I have hereunto set my hand and seal this twenty-sixth day of September, A. D. eighteen hundred and sixty-four.

ASA M. SWAIN. [SEAL.]

Sealed and delivered in presence of—
HORACE GRAVES.
DAN. A. GLEASON.

Received and recorded Sept. 29, 1864.

[5-cent stamp.—A. M. S., Sept. 26, 1864.]

24 (2) Liber K⁷, page 405.

Whereas we, I. H. Jones, junior, of Boston, in the county of Suffolk, and George W. Coombs, of Wrentham, in the county of Norfolk, both in the commonwealth of Massachusetts, the assignees named in a certain deed of assignment executed by A. M. Swain, of North Chelmsford, in the county of Middlesex, and said commonwealth, dated September twenty-six, eighteen hundred and sixty-four, and recorded in the Patent Office of the United States in Liber P⁷, page 26, of Transfers of Patents, are the owners of one undivided half part of all the right, title and interest in or to certain valuable improvements in water wheels, as secured to said Swain by letters patent of the United States, which letters patent bear date of the fifteenth day of September, A. D. eighteen hundred and sixty; and whereas the Swain Turbine Company, a corporation organized under the laws of said commonwealth, and located in Boston aforesaid, are desirous of acquiring all our right, title and interest in said patent:

Now this indenture witnesseth, that for and in consideration of the sum of twenty thousand dollars to us paid, the receipt of which is hereby acknowledged, we have assigned, sold and set over, and do by these presents sell, assign and set over unto said the Swain Turbine Company, one undivided half part of all the right, title and interest in and to said improvement in water wheels as secured to said Swain by letters patent aforesaid, it being our intention to assign to the Swain Turbine Company all the right, title and interest which we or either of us has by virtue of said assignment from A. M. Swain, hereinbefore referred to; the same to be held and enjoyed by the Swain Turbine Company for their own use and behoof, and for the use and behoof of their legal representatives and assigns to the full end of the term for which said letters patent are or may be granted or extended as fully and entirely as the same would have been held and enjoyed by us had this assignment and sale not been made.

25 In witness whereof we have hereunto set our hands and seals this twentieth day of October, A. D. eighteen hundred and sixty-four.

Sealed and delivered in presence of—

I. H. JONES, JR. [SEAL.]
GEO. W. COOMBS. [SEAL.]

Middlesex erased and Norfolk inserted on first page before signing.
R. D. SMITH,
JOSEPH WILLARD, Jr.

Received Nov. 5, 1864, and recorded Nov. 9, 1864.
[5-cent stamp.—I. H. J. jr., Oct. 20, 1864.]

(3) Liber K⁷, page 406.

Whereas I, A. M. Swain, of North Chelmsford, in the county of Middlesex and commonwealth of Massachusetts, formerly of Lowell, in said county, did obtain letters patent of the United States for certain improvements in water wheels, which letters patent bear date of the fifteenth day of May, A. D. eighteen hundred and sixty;

And whereas the Swain Turbine Company, a corporation organized under the laws of said commonwealth, and located in Boston, in the

county of Suffolk, and said commonwealth, are desirous of acquiring all my remaining interest therein:

Now, this indenture witnesseth, that for and in consideration of the sum of twenty thousand dollars to me paid, the receipt of which is hereby acknowledged, I have assigned, sold and set over, and do by these presents sell, assign and set over unto said the Swain Turbine Company, one undivided half part of all the right, title and interest in and to said invention as secured to me by said letters patent, I having previously assigned one undivided half part of all the interest in said patent, and it being my intention to assign all my remaining interest in said patent by this indenture; the same to be held and enjoyed by the Swain Turbine Company for their own use and behoof, and for the use and behoof of their legal representatives and assigns, to the full end of
the term for which said letters patent are or may be granted or
26 extended, as fully and entirely as the same would have been
held and enjoyed by me had this assignment and sale not been made.

In witness whereof I have hereunto set my hand and seal this twentieth day of October, A. D. eighteen hundred and sixty-four.

ASA M. SWAIN. [SEAL.]

Sealed and delivered in presence of—
R. D. SMITH.
JOSEPH WILLIARD, Jr.

Rec'd Nov. 5, 1864, and recorded Nov. 9, 1864.

[5-cent stamp.—A. M. S, Oct. 20th, 1864.]

(4) Liber O⁷, page 200.

Know all men by these presents:

That we, I. H. Jones, jr., of Boston, in the county of Suffolk, and George W. Coombs, of Wrentham, in the county of Norfolk, and said commonwealth of Massachusetts, in consideration of one dollar to us paid, and of other good and valuable considerations, the receipt of which is acknowledged, do hereby assign, sell and set over to the Swain Turbine Company all our right, title and interest in or to certain valuable improvements in water wheels as secured to one Asa M. Swain by letters patent of the United States, bearing date of the fifteenth day of May, A. D. eighteen hundred and sixty. It being our intention hereby to correct a mistake in the description of said patent made in an assignment from us to said assignee, which assignment bears date of the twentieth day of October, A. D. eighteen hundred and sixty-four, and is recorded in Liber K⁷, page 405, of Transfers of Patents, in the Patent Office of the United States, and to confirm the title of said assignee to the same, to the end that all rights intended to be conveyed by said assignment may be held and enjoyed by the Swain Turbine Company aforesaid, its legal representatives and assigns, as fully as if said assignment had been correct in every particular.

27 In witness whereof we have hereunto set our hands and seals this first day of December, A. D. eighteen hundred and sixty-four.

I. H. JONES, JR. [SEAL.]
GEO. W. COOMBS. [SEAL.]

Sealed and delivered in presence of *of*—
DAN. A. GLEASON.
A. M. SWAIN.

Massachusetts interlined on first page before signing.

Received and recorded Dec. 5, 1864.

(5) Liber V[17], page 241.

Whereas A. M. Swain, of North Chelmsford, Mass., is about to make application for the extension of letters patent, granted to him May 15, 1860, and reissued to the Swain Turbine Company, as assignees, November 19, 1872, for improvement in water wheels; and whereas the Swain Turbine Company are desirous of purchasing said letters patent when extended:

Now, therefore, this memorandum of agreement witnesseth that said A. M. Swain has agreed, and by these presents does agree, to sell, assign, and set over to said Swain Turbine Company any and all right, title, and interest he may *re*quire in said extended letters patent and the invention thereby secured. Said sale and assignment to take full effect immediately upon the granting of said extension and by virtue thereof. In consideration of said sale and assignment, as soon as said extension is granted, the said Swain Turbine Company agree to pay to said A. M. Swain the sum of eighteen thousand two hundred $\frac{00}{100}$ dollars, together with all the patterns and drawings which said Swain Turbine Company now have made for all sizes of Swain turbine wheels, from twenty-four inches and under, inclusive; and said Swain Turbine Company further agree to grant unto said A. M. Swain the exclusive right and license to make and sell all sizes of said Swain turbine wheels, from twenty-four inches and under, inclusive, for the full term for which said extension may be granted, to full extent of their interest therein; said payment of said eighteen thousand two hundred $\frac{00}{100}$ dollars to become due
28 and payable, and said transfers of patterns and drawings and said license to take effect each and all upon the granting of said extension, and simultaneous to the sale and assignment of said extended grant and privileges by said A. M. Swain to said Swain Turbine Company; and it is further agreed by the parties hereto, and as a part of aforesaid agreements, that such part of and so much of any and all assignments heretofore made by said A. M. Swain to said Swain Turbine Company, wherein he assigns, sells, or sets over to said Swain Turbine Company any part of said extension or any interest therein, is to become null and void and of no effect simultaneously with the granting of said extension and taking effect of this agreement.

Dated at Lowell this twenty-second day of December, A. D. 1873.

A. M. SWAIN.

SWAIN TURBINE COMPANY, { SWAIN L. S. TURBINE CO. }

By H. W. BOARDMAN,
Attorney and Agent.

Recorded May 20, 1874.

(6) Liber V[18], page 404.

For certain considerations and subject to certain conditions named in the memorandum of agreement made and executed on the second day of June, 1874, by and between the Swain Turbine Company and the Swain Turbine and Manufacturing Company, both corporations being duly organized by and under the laws of Massachusetts, and having their usual places of business in the city of Lowell, Mass.;

The Swain Turbine Company hereby sell, assign, and set over to the said Swain Turbine and Manufacturing Company and their successors

all their right, title, and interest in and to the letters patent of the United States, and the invention thereby secured for an improvement in water wheels, granted to Asa M. Swain May 15, 1860, reissued November 19, 1872, and extended for seven years from May 15, 1874, the same to be held and enjoyed by the Swain Turbine and Manufacturing Company to the full end of said extended term as fully and entirely as the same would have been held and enjoyed by said Swain Turbine Company if this sale and assignment had not been made.

In witness whereof, the Swain Turbine Company have executed this instrument by H. W. Boardman, its agent and attorney, duly authorized, this second day of June, A. D. 1874.

THE SWAIN TURBINE COMPANY,
By H. W. BOARDMAN,
Their Ag't & Att'y.

Recorded Jan. 25, 1875.

Deposition of Albert F. Nichols.

BOSTON, *June* 24, 1875.

Direct examination by counsel for complainant:

Int. 1. Please state your name, age, residence, and occupation.

Ans. Albert F. Nichols; forty; Lowell, Mass.; manufacturer.

Int. 2. Do you sustain any relation to or exercise the duties of any officer of the Swain Turbine Company; and, if yea, what?

Ans. Yes, sir; I am treasurer of the company, and clerk.

Int. 3. How long have you acted in that capacity?

Ans. Since 1869.

Int. 4. Do you sustain any relation to or exercise the duties of any officer of the Swain Turbine and Manufacturing Company; if yea, what?

Ans. Yes, sir; clerk and treasurer of that.

Int. 5. How long have you acted in that capacity?

Ans. One year, this month.

Int. 6. Have you examined the records of the doings of the stockholders and also of the directors of the said Swain Turbine Company, so as to be able to state whether there is any recorded vote in relation to any authorization of H. W. Boardman to execute in behalf of said Swain Turbine Company any assignment of its interest in any letters patent, especially in letters patent granted to Asa M. Swain, dated May 15, 1860, reissued Nov. 19, 1872, and extended for seven years from May 15, 1874?

Ans. Yes, sir.

30 Int. 7. Is there any such recorded vote?

Ans. No, sir.

Int. 8. Were you present at any meeting of the stockholders of said Swain Turbine Company when the subject of such assignment was considered and acted upon or decided? If yea, state as accurately as you can when such a meeting was held.

Ans. Yes, sir; I think it was in June, 1874.

Int. 9. On that occasion and after the termination of that meeting, state whether there was a meeting upon the same day of the directors of said Swain Turbine Company.

Ans. Yes, sir.

Int. 10. At said stockholders' meeting what, if anything, was done or agreed in relation to having the assignment of said letters patent of the Swain Turbine and Manufacturing Company made or executed by said Boardman?

Ans. He was given authority to execute all the papers and do all the business that was necessary to be done.

Int. 11. State whether the same subject came up at the said meeting of the directors; and what, if anything, was done or agreed by the directors touching that matter.

Ans. He was authorized to go on and do everything that was necessary.

Int. 12. Since June 2, 1874, what, if anything, have you done in behalf of the Swain Turbine and Manufacturing Company in relation to the manufacture and the sale of water wheels made under said patent?

Ans. Carried on the business.

(The defendant's counsel seasonably objected to the sixth, seventh, eighth, tenth, and eleventh interrogatories as incompetent.)

Int. 13. Since June 2, 1874, and prior to February, 1875, what number of water wheels have been made for the said Swain Turbine and Manufacturing Company or by said company under said Swain patent?

Ans. From ten to fifteen.

Int. 14. State as accurately as you can the gross amount of sales of such wheels made by or for said Swain Turbine and Manufactur-
31 ing Company during said time. I mean between the second of June, 1874, and February, 1875.

Ans. About $30,000.

Int. 15. What company received the proceeds of said sales?

Ans. The Swain Turbine and Manufacturing Company.

Int. 16. During the same time—I mean the period between the second of June, 1874, and February, 1875—were such wheels sold by licensees of the said Swain Turbine and Manufacturing Company? If yea, state the number of wheels so sold as accurately as you can.

Ans. Yes, sir; some twenty-five or thirty.

Int. 17. What company received the license fees arising from such sales?

Ans. The Swain Turbine and Manufacturing Company.

Int. 18. Please examine copy of assignment now shown you, already introduced into this case, dated June 2, 1874, and purporting to have been executed by "the Swain Turbine Company, by H. W. Boardman, their ag't & att'y" and state (if you know) whether the consideration for said assignment was paid by the Swain Turbine and Manufacturing Company to or for the Swain Turbine Company prior to November last.

Ans. Yes, sir; I have examined it; it was so paid.

Int. 19. Since June 2, 1874, what, if anything, has the Swain Turbine Company done in the manufacture or sale of water wheels made under the said Swain patent, or in licensing others to make and sell such wheels?

Ans. Nothing, only to close up the jobs they had begun.

Int. 20. Since said June 2, 1874, has the said Swain Turbine Company, to your knowledge or information, claimed any interest in said letters patent, or any right under the same, excepting the right to complete previous contracts and claims on account of prior infringement?

(Objected to as incompetent.)

Ans. No, sir.

Int. 21. Please examine Exhibit B, particularly the drawings and claims 1, 2, 3 and 5, and state whether you have been acquainted with

the same, and whether you have manufactured or superintended
32 the manufacture of water wheels made in accordance therewith, or including the elements stated in said claims 1, 2, 3 and 5.

Ans. Yes, sir; I have examined the patent and have superintended making the wheels referred to.

Int. 22. State whether you have also superintended the setting and putting into operation of the wheels so made.

Ans. Yes, sir.

Int. 23. For whom or for what company have you so acted since June 2, 1874?

Ans. For the Swain Turbine and Manufacturing Company.

(The complainant's counsel here puts into the case the thirty-inch wheel produced by defendant in accordance with the stipulation, and the same is hereby marked "Exhibit D"; and it is agreed that in case a model shall be hereafter substituted, as herein before stipulated, that it shall be marked in the same way.)

Int. 24. Have you examined said wheel marked "Exhibit D"?

Ans. Yes, sir.

Int. 25. Please refer to the first claim in said reissued patent, marked "Exhibit B," which is in the following words, viz: "1. A water wheel, the floats of which have a discharge line extending from the crown at their inner edge to the lower outer edge of the wheel," and then state whether or not you find in said wheel, Exhibit D, the same elements and the same construction as described in said claim.

Ans. Yes, sir. I have examined it and find the same elements and the construction is the same.

Int. 26. Now please examine the second claim in said reissued patent, which is, "2. The combination, in a water wheel, of a crown, band and floats, having their discharge line extending from the crown at their inner edge to their lower outer edge," and state whether or not you find in said wheel, marked Exhibit D, a combination of a crown, band and floats, having their discharge line extending from the crown at their inner edge to their lower outer edge.

(Interrogatories 25 and 26 seasonably objected to as incompetent.)

Ans. I have. I find the same.

Int. 27. Please examine the claim 5, in said Exhibit B, which
33 is, "5. A water wheel having an effective inward flow and discharge of part of the water and an effective downward flow and discharge of part of the water simultaneously in one wheel, whereby the effective area of discharge is increased without increasing the diameter of the wheel," and state whether or not the wheel marked Exhibit D contains the same elements described in this claim, and whether or not it is so constructed as to have an effective inward flow and discharge of part of the water, and an effective downward flow and discharge of part ot the water, as described in said claim.

(Objected to as before.)

A. Yes, it does not contain the same elements described in this claim, and it is so constructed as to have an effective inward flow and discharge of part of the water, and an effective downward flow and discharge of part of the water, as described in said claim.

Cross-examination by counsel for defendant:

Cross-int. 28. Please state, generally, what experience you have had as an expert in the trial of patent causes in the United States courts.

Ans. This is my first experience.

Cross-int. 29. In answering int. 25, what force did you give to the

word "element" in the question and what force to the word "construction," as contained in said question?

Ans. I meant receiving the water in the same direction as our wheel, and the construction in the same manner.

Cross-int. 30. The question was intended to draw out a description of those features of construction which you find in the plaintiff's patent, and which you regard as essential to its identity as a patented structure.

Ans. I mean the angles and curves of the bucket and the crown, and of the band.

Cross-int. 31. What angles and curves of the buckets and crown, and of the band?

Ans. The top of the bucket of the outer edge passing inward in the crown, and the curve downward to the band on the outer edge of the bucket.

34 Cross-int. 32. What feature of construction is, in your judgment, alluded to in the following language in the specification of the original patent, viz: "When J is lowered the water strikes the floats with all the force and velocity due to its head directly under the rim of the wheel, which is so curved as to force the water down rapidly on the lower curved parts or bottoms of the floats"?

(Objected to as incompetent and inadmissible in cross-examination, and because the construction of the patent and of this descriptive part is for the court, and this objection will be insisted on at the hearing.)

Ans. I should say that the head of water on the wheel forced it inward and downward both.

Cross-int. 33. What part of the wheel do you understand as referred to as "so curved as to force the water down rapidly on the lower curved parts or bottoms of the floats"; is it not the under surface of the crown from the rim of the wheel inward?

(Objected to as above, and because the question does not relate to any matter gone into in direct examination, and because this witness has not been introduced as a general expert, but only to state certain points of identity between the wheel Exhibit D and the patented "Swain wheel," so called. This objection and all other objections by plaintiff's counsel will be insisted on at the hearing.)

Ans. I should say that all of its constructions were for that purpose of forcing it inward and downward.

Cross-int. 34. (Question repeated.)

(Objection repeated.)

Ans. I should say that that retarded the direction of the water or changed its course, so that it went down.

Cross-int. 35. And is this curved under surface of the crown one of the curves of the crown referred to in your answer to cross-int. 30?

Ans. Yes, sir.

Cross-int. 36. Is not the under surface of the crown in Exhibit D from the rim inward to the discharge edges of the floats horizontal?

Ans. It is very near.

Cross-int. 37. Is it not, for all practical purposes, horizontal?

35 Ans. I should think it might be.

Cross-int. 38. You are supposed to understand the construction and operation of these wheels; can you not answer the question directly?

(The last question repeated.)

Ans. I should prefer not to answer it till I measured it.

Cross-int. 39. Is it so nearly horizontal that you cannot determine by the eye, without measuring?

Ans. Yes, sir.

Cross-int. 40. Will you please measure it?

Ans. I will.

(Witness goes to measure Exhibit D, and returns.)

Cross-int. 41. Please now state the result of your measurement.

Ans. I am unable to do so until I find a straight edge, but will do so when I find one.

Cross-int. 42. If you are not able to determine, without the use of a straight edge, whether or not the under surface of the crown in Exhibit D, between its rim and the discharge edges of the floats, is exactly horizontal, are you able to swear as an expert that it is not horizontal for all practical purposes?

(Objected to same as to cross-int. 33.)

Ans. No, sir.

Cross-int. 43. Do you not believe that it is horizontal for all practical purposes?

(Objected to as above, and because the belief of the witness is inadmissible.)

Ans. I cannot tell without it is measured.

Cross-int. 44. Do you mean that you have no belief on the subject? And please to understand that I do not allude to the question whether it is exactly horizontal, but to the question whether it is horizontal for all practical purposes; with this explanation, do you not believe that it is?

(Objected to as before.)

Ans. My belief is that it may be.

Cross-int. 45. Do you not now believe that it is, in fact?

(Objected to as before.)

Ans. I don't know it to be a fact.

36 Cross-int. 46. The question relates to your best opinion as an expert, acquainted with the theory and operation of water wheels, and not to that exactness of knowledge which measurement would afford. With this explanation, please answer the last question.

(Objected to as before, and because it is not claimed, and has not been shown nor admitted that the witness is an expert, acquainted with the theory and operation of water wheels.)

Ans. I don't know. I can't tell.

Cross-int. 47. Have you not sufficient knowledge of the practical operation of turbine water wheels to be able to say whether or not it is horizontal for all practical purposes for turbine water wheels, it being impossible for you to determine without a straight edge whether it is not exactly horizontal?

Ans. No, sir; I think not.

Adjourned.

BOSTON, *June* 25, 1875.

Cross-int. 48. Do the same curves of crown, band and floats, which you have spoken of as characterizing the construction referred to in the first claim of the Swain reissued letters patent, characterize said crown, band, and floats as found in the second claim of said letters patent?

(Objected to as before.)

Ans. I should say the mechanical construction of them was the same.

Cross-int. 49. In your answer to int. 27, what meaning do you attach to the word "effective," as a term descriptive of mechanical construction?

Ans. I should say, mechanically, the word "effective" meant the combination of two wheels, the inward and the downward, without increasing the diameter of the wheel.

Cross-int. 50. If the word "effective" is descriptive of the combination, and means the same as the combination, what, in your judgment, is the structural significance of the words "effectively combined," as found in lines eight and nine of the Swain reissue?

(Objected to as before.)

Ans. I don't understand your question so that I can answer it.

Cross-int. 51. I want to know what, in your judgment, is the
37 construction described in the Swain reissue, which makes it, as it is claimed, not only a combination "in one wheel, of the elements of an inward flow turbine, and a downward flow turbine," but also an "effective" combination of those two species of wheels? Does not such effectiveness, if any such characteristic it has, reside in the fact that a horizontal plane, cutting the buckets at a point midway between the under side of the crown and the top of the band, on the periphery of the wheel, would divide the wheel under consideration into two wheels: the one a perfect centre-vent wheel, with the exception of the lower crown, and the other, a perfect downward discharge, with the exception of the inward boundary of the floats?

(Objected to as before.)

Ans. Mechanically, I should say if you put your partition or crown through the bucket and between the space of the bucket, with the outer edge of the bucket running down in a straight line and the inner edge in a straight line, you would have a centre vent, and the lower part with a bucket curved, and the inner edge of the bucket closed, so that the water discharged at the bottom of the bucket, you would have a downward flow.

Cross int. 52. Are you acquainted with the "Leffell wheel"?

Ans. Nothing, only by observation. I have seen perhaps two or three of them.

Cross int. 53. Do you know whether or not in the "Leffell wheel" there are found a centre vent wheel, and also a downward discharge wheel in one structure, the two being separated by a horizontal diaphragm?

(Objected to as improper in cross-examination, and introducing a subject not inquired about in direct examination.)

Ans. No, sir; I never examined a "Leffel! wheel" closely at all.

Cross-int. 54. I see that, in your answer to cross-int. 51, you intended to frame a complete answer, but the question is for clearness now repeated, and your attention is called to the fact that the question asks, whether the effectiveness of the combination described in the reissue does not reside in the fact that a horizontal plane, cutting the wheel as described in said question, would divide it into two typical wheels: the
upper one, a centre-vent wheel, and the lower one, a downward
38 discharge wheel, the centre-vent wheel in the supposed case lacking only the lower rim or crown, and the downward discharge wheel lacking an inner boundary to the floats. To avoid misapprehension, I will ask you to read the question carefully, and answer yes or no, if you can.

(Objected to, same as to cross-int. 51.)

Ans. I don't exactly understand it.

Cross-int. 55. Please state wherein your difficulty consists in endeavoring to answer the question.

Ans. The centre vent I think I understand, but the lower part of the

wheel, the inner edges of the bucket closed so as to leave it open at the bottom, and the water, discharging at the bottom, would have a downward flow. If you mean to leave the inner side of the buckets open, you would have an inward and a downward wheel at the bottom, that is, the water discharging inwardly and downwardly.

Cross-int. 56. I mean that in the downward discharge part of the wheel the buckets should be closed on the inside, but open at the bottom, so as to admit of a downward discharge. With this explanation, please state whether the efficiency of the combination described in the reissue does not reside in the fact that the plane cutting the buckets as supposed in cross-interrogatory fifty-one would make two wheels—the one a centre vent and the other a downward vent—and each having the efficiency of a typical wheel of its kind.

(Objected to, as to cross-int. 51.)

Ans. I should say no, it doesn't.

Cross-int. 57. Would not a horizontal plane, cutting the device described in the reissue as supposed in cross-interrogatory fifty-one, leave a typical centre-vent wheel above such plane, with the exception that it would lack a lower rim or crown underneath the floats? And for the purpose of answering this question, please note the following language near the bottom of the first column of the printed specification of Exhibit B: "The upper horizontal edge of the floats is attached to the crown of the wheel."

(Objected to as before.)

Ans. It would be a centre-vent wheel, with the buckets set at an angle from the centre, and the inner edge of the buckets left open for the water to discharge ont.

39 Cross-int. 58. Would it be a perfect centre vent wheel?

Ans. I don't know that I am competent to answer that.

Cross-int. 59. Would it be a typical centre vent wheel?

Ans. I should say it would.

(It is agreed that the various models heretofore used on the application for a preliminary injunction in this case, as follows: model purporting to be duplicate of model filed in the Patent Office on application for original Swain patent, marked Exhibit E, and stamped with a letter K on the edge of the crown; also six-inch wheel manufactured by complainant, marked Exhibit F, and stamped 3 on the top of the crown; also centre vent wheel marked G, with the letter A stamped on top; also downward vent wheel, marked Exhibit H, with the letter L stamped on top, are now introduced by consent, in evidence in this case.)

Cross-int. 60. Please look at Exhibit F, and state if the same is a correct representation of the wheels manufactured by the Swain Turbine and Manufacturing Company.

Ans. Mechanically speaking, I should say it was very near.

Cross-int. 61. Is that wheel, Exhibit F, an effective combination of an inward discharge wheel and a downward discharge wheel?

Ans. It is.

Cross-int. 62. Is that wheel a fair specimen of the result of the efforts of the Swain Turbine and Manufacturing Company to combine in one wheel, effectively, an inward flow turbine and a downward flow turbine?

Ans. Yes, sir.

Cross-int. 63. What necessity requires that in an effective combination of the two wheels in question, to wit, the centre vent and downward vent, more than three-fourths of the height of the float upon the

periphery of the wheel should be bent backward so as to operate Jouval-wise, or in the direction of downward discharge?

(Objected to as implying what has not been admitted or proved, and as an improper question, except to a professional expert.)

Ans. I am not expert enough to answer that; neither can it be answered, except by a scientific man. It has been found by our tests that the curves and angles in our buckets have shown good results.

Cross-int. 64. Has it not been found by your tests, that the
40 curves adopted by you, including the one mentioned in the last question, are essential to the best results; that is to say, to an effective combination in one compound wheel of the two wheels therein embodied?

Ans. Yes, sir; by that and other experiments.

Cross-int. 65. As the water enters the wheel represented by Exhibit F, and divides itself so that one portion operates centre vent wise, and the other portion operates downward vent wise, does not the upper portion of the water so entering operate in the first mentioned manner, and the lower portion of the water so entering operate in the second mentioned manner?

Ans. Yes, sir.

Cross-int. 66. Now, sir, could the lower portion of the water so entering the wheel, immediately and effectively commence to operate in its appropriate manner, to wit, Jouval-wise, unless the lower half of the outer edge of the bucket between the crown and the upper edge of the band were bent backward from a perpendicular, in the manner common to the Jouval type of wheel?

(Objected to as improper, except to a professional expert.)

Ans. I can't tell.

Cross-int. 67. Do you mean to say that you can't tell whether or not water will act Jouval-wise, unless the buckets are so shaped as to enable it to act Jouval-wise?

Ans. No, sir. I mean to say I think they will act in combination, the two together.

Cross-int. 68. What shape of float is necessary to get an effective downward discharge? Is it not a form which curves backward as it descends?

(Objected to, same as to cross-int. 66.)

Ans. Mechanically, I should say, it would be a float when the outer edge and the inner edge of the buckets would have a rim set at some angle, the water passing inwards meeting this inward obstruction.

Cross-int. 69. Question repeated.

(Objection same as before.)

Ans. Generally speaking, yes.

Cross-int. 70. Is there any exception?

41 Ans. Mechanically, I should say no.

Cross-int. 71. In view of this fact, could the lower half of the water entering the wheel Exhibit F, immediately and effectively commence to operate—as you have stated it does operate—in a downward discharge direction, unless the lower half of the float between the crown and the band upon which such water so entering first impinges were curved backward, in the manner essential to the Jouval type of float?

(Objected to, same as to cross int. 66.)

Ans. Mechanically, I should say it could not.

Cross-int. 72. Please look at Exhibit H, which I understand to be a typical Jouval wheel, and state if it be not a characteristic and essen-

tial feature of its construction that the floats extend backward as well as downward from the extreme uppermost line where the water impinges upon it.

(Objected to because whether "essential" or not, it should only be asked of a professional expert.)

Ans. I should think they did.

Cross-int. 73. Have you any doubt about it?

Ans. No, sir.

Cross-int. 74 (de bene esse). You have spoke of a stockholders' and directors' meeting at which you were present in June, 1874, at which you say authority was given to Mr. Boardman to execute the papers and do all that was necessary to be done in relation to the assignment of the letters-patent of Swain; where were those meetings held?

Ans. They were held in Lowell, at the Swain Turbine Company's office, corner of Willey and Dutton streets.

Cross-int 75 (de bene esse). Were the votes referred to reduced to writing at that meeting?

(Objected to because no votes are referred to as implied in the question.)

Ans. No, sir.

Cross int. 76 (de bene esse). Were there any votes of either of the stockholders or the directors on that subject?

Ans. I think there were.

42 Cross-int. 77 (de bene esse). Were you clerk or secretary of the corporation at that time?

Ans. Yes, sir; I was.

Cross-int. 78 (de bene esse). Did you make a record of those meetings?

Ans. Yes, sir.

(Counsel for the defendant call for the production of the records of the corporation, and give notice that if not produced in the plaintiff's case, they will insist upon their objection to the competency of all evidence outside of the records, as to transactions of the company.

Counsel for complainant say that the records of the company are not present, but they will be produced hereafter.)

Cross-int. 79 (de bene esse). Why did you not record the votes you speak of with the records of these meetings?

Ans. I don't know any reason, unless it was an oversight. We meet and talk over business, and time flies along to the last minute, and our president is obliged to go to the depot to take the cars, and having so much business going on in the office, I must have let it slip, and not have made a record of it.

Cross-int. 80 (de bene esse). You state the substance of the vote, then, from mere recollection, as I understand it?

Ans. Yes, sir; the transactions since that time, and the talk of the business of the unanimous wishes, and consenting to the transactions.

Cross-int. 81 (de bene esse). Were the meetings held the same day that the assignment was executed by Mr. Boardman, namely, June 2, 1874?

Ans. Yes, sir.

Cross-int. 82. (de bene esse). Was the proposed assignment present at the meetings, and submitted to the stockholders and directors?

Ans. Yes, sir.

Cross-int. 83 (de bene esse). The assignment refers to a memorandum of agreement made and executed June 2, 1874, by and between the Swain Turbine Company and the Swain Turbine and Manufacturing

Company; was that memorandum of agreement present at the stock holders' and directors' meeting on that day?

43 Ans. Yes.

Cross-int. 84. (de bene esse). Did the votes of those meetings include the power to Mr. Boardman to execute that memorandum of agreement, or had it been executed already?

Ans. Yes, sir; it included the power to Mr. Boardman to execute it; the papers were all there.

Cross-int. 85 (de bene esse). Where is that memoradum of agreement?

Ans. I can't tell you where it is; our president read it over at the time, and I think Mr. Boardman has it, or our president, I can't say which.

Cross int. 86 (de bene esse). You are clerk of the corporation; have you a copy of that memorandum of agreement?

Ans. No, sir.

Cross-int. 87 (de bene esse). Is it recorded on the records of either the Swain Turbine Company or the Swain Turbine and Manufacturing Company?

Ans. No, sir; I think not.

(Counsel for the defendant call upon the complainant to produce said memorandum.

Counsel for complainant, before closing their testimony, will deci whether to produce said memorandum of agreement, in case it can found.

Counsel for the complainant give notice that if not produced they will claim the right to recall the witness for further cross-examination upon this subject.)

Cross-int. 88 (de bene esse). I have understood you to testify that the considerations of this assignment of June 2, 1874, were paid before November last; what were these considerations?

Ans. They were four-months notes, given previous to the assignment and maturing from time to time previous to November last.

Cross-int. 89 (de bene esse). Amounting in all to how much?

Ans. From $125.000 to $150,000.

Cross-int. 90 (de bene esse). Did the consideration of these notes include the business and good will of the Swain Turbine Company?

Ans. Yes, sir.

Cross-int. 91 (de bene esse). Were these notes paid in money?

44 Ans. Yes, sir; money and drafts; whatever I had come in.

Cross-int. 92 (de bene esse). At the time of this assignment, executed by Mr. Boardman for the Swain Turbine Company, June 2, 1874, was he an officer of the company?

Ans. Yes, sir; acting agent and selling agent.

Cross-int. 93 (de bene esse). What were the circumstances which made it necessary or desirable that the Swain Turbine and Manufacturing Company should be organized and make this purchase from the Swain Turbine Company?

Ans. It was that we might increase our facilities in doing our business, carry a larger stock of wheels, and furnish a mill throughout with the prime movers, such as shafting, gears, and pulleys in connection with the turbine wheels.

Cross-int. 94 (de bene esse). Why was the organization of the new company and its purchase of the old company necessary for this?

Ans. Because, as we were known as the Swain Turbine Company,

we made only wheels, and we wished to put the "Manufacturing" to our name to show that we made other parts of machinery.

Cross-int. 95 (de bene esse). In the memorandum of agreement, dated December 22, 1873, which has been put in evidence, it is provided that upon the extension of the Swain patent, the Swain Turbine Company should pay Swain $18,200; was that payment ever made?

(Objected to as immaterial.)

Ans. Yes, sir.

Cross-int. 96 (de bene esse). In what shape and when?

Ans. Part of it in notes, and part in wheels; and when the notes became due they were paid in cash.

ALBERT F. NICHOLS.

Attest:

JOHN G. STETSON,
Examiner.

45 *Deposition of William C. Hibbard.*

BOSTON, *June* 30, 1875.

Direct examination by counsel for complainant:

Int. 1. Please state your name, age, residence, and occupation.

Ans. William C. Hibbard; age, sixty; Boston; mechanical engineer, and expert in patent cases.

Int. 2. For how long a time have you testified as an expert in patent cases, and whether frequently, or otherwise?

Ans. I have acted in that capacity, more or less frequently, for more than twenty-five years, and for the last ten years it has been the larger part of my business.

Int. 3. Have you carefully examined Exhibit B, being copy of reissue letters patent, and particularly the description or specifications and the claims numbered 1, 2, 3, and 5, and do you understand the same?

Ans. I have examined the exhibit mentioned, embracing the claims mentioned, and believe I understand the construction of the mechanism described, and its mode of operation.

Int. 4. Have you examined Exhibit D, being a thirty-inch wheel, introduced into this case?

Ans. I have.

Int. 5. Please describe said wheel, Exhibit D, in reference to or in its relation to said reissued patent, Exhibit B, referring particularly to claims numbered 1, 2, 3, and 5, and state fully whether and wherein said wheel, Exhibit D, includes or embraces the elements and mechanical construction stated or described in said claims.

Ans. The claims referred to which are indicated in the interrogatory, relate to the construction of the floats or buckets and their connection with the part of the wheel called the crown and also the part called the band. The crown is the upper plate of the wheel, to which also is connected a central boss which receives the shaft of the wheel. The floats of the wheel are curved plates in an upright position attached to the crown at the top, with their outer edges approximately radial to the
46 wheel, and extending downward to the bottom of the wheel. At the lower part of the buckets or floats they are attached to a circumferential band, which connects all the lower parts of the floats together, and causes them to mutually support each other. The water which drives the wheel enters between the crown and this band in a horizon-

tal direction through suitable chutes, and after acting upon the several floats escapes into the interior space within the wheel and below it, and in intermediate directions between the two. On comparing Exhibit D with the wheel shown in the reissue, it appears to have each and every property that I have enumerated as characterizing the Swain wheel as shown in the reiasue, differing a little in proportion in some parts, but apparently embodying each and every principle in construction in this respect that is described in the specification or shown in the drawing, and apparently for precisely the same purpose; and they are so nearly alike that their substantial similarity is obvious upon cursory inspection.

(No cross-examination.)

WM. C. HIBBARD.

Attest:

JOHN G. STETSON,
Examiner.

47 EVIDENCE FOR DEFENDANT.

Taken pursuant to the sixty-seventh rule of the Supreme Court of the United States, in equity, as amended, before me.

EDWIN E. MARVIN,
Commissioner.

HARTFORD, CONN., *July* 30, 1875.

Present, John S. Abbott, esq., of counsel for complainant; Charles E. Mitchell, esq., of counsel for defendant.

Deposition of John L. Stowe.

Direct examination by C. E. MITCHELL, esq., of counsel for defendant:

Int. 1. What is your name, age, residence, and occupation?

Ans. John L. Stowe; fifty-five years old; reside in Newark, New Jersey, 14 Nassau street; occupation is millwright and engineer, and also builder of water-wheels.

Int. 2. State whether or not you are at present manufacturing a particular kind of wheel; and, if so, by what name it is called?

Ans. I am manufacturing a wheel called the Stowe turbine wheel for another man. His name is E. W. Roff, of Newark, New Jersey.

Int. 3. Have you a specimen of the Stowe wheel present? And, if so, produce the same.

(Question objected to as incompetent and inadmissible.)

Ans. I have, and herewith produce the same.

(Turbine wheel and case produced, and marked Exhibit 1, E. E. M., com'r.)

Int. 4. When did you first make a water-wheel of the kind contained in Exhibit 1?

(Question objected to as incompetent and inadmissible, as implying a fact neither proved nor admitted, and as asking for an opinion or comparison to be given or made only by a proved expert.)

Ans. In July, 1837.

Int. 5. Where did you make it, and for whom?

48 (Question objected to for same reasons as were made to int. 4.)

Ans. In the town of Halifax, Vt., for David Fisher.

Int. 6. State if a model has been constructed of said wheel under your direction, and, if so, please produce the same.

(Question objected to as incompetent and inadmissible.)

Ans. There has, and there it is.

(Model produced and marked Exhibit 2, E. E. M., com'r.)

Int. 7. Please look at the model, and state whether or not it in all respects correctly exhibits the wheel made by you for David Fisher, at Halifax, Vermont, in the year 1837, as you have stated.

(Question objected for the same reasons as to int. 6, and because leading.)

Ans. It does.

Int. 8. What was the size of the wheel made for David Fisher?

Ans. Seven feet in diameter.

Int. 9. To avoid numerous questions, I will ask you generally whether or not all the proportions of the Fisher wheel were substantially as shown by this model?

(Question objected to for same reasons as to int. 4, and because leading.)

Ans. They were.

Int. 10. Of what material was it made?

Ans. Wood and iron combined. The band sustaining the lower end of the buckets was iron; the bolts that hold the buckets to the crown were iron, as also the bolts that held the spokes to the crown; the end of the shaft resting on the step was iron; the rest was made of wood.

Int. 11. What object did you have in view in making the discharge line of the buckets extend downward to the crown and outward to the band, as shown in Exhibit 2?

(Question objected to for same reasons as to int. 4, and because it has not been properly proved that the Fisher wheel was like Exhibit 2.)

Ans. The object was to retain the direct and inward and downward pressure of the water.

Int. 12. Please explain more fully what you mean by the direct and inward and downward pressure of the water, describing each separately, in the order given.

49 (Question objected to for the same reasons as to int. 11.)

Ans. The water being received at right angles to the radius line, the second form of the bucket received the direct force; the third form received the inward force; the fourth form received the downward force and the combination between the downward and inward force.

Int. 13. You say the second form of the bucket received the direct force of the water as it entered at right angles to the radius line. What was the first form of the bucket, and what did you seek to accomplish thereby?

Ans. The outer edge of the bucket turned backward, forming a hook for the purpose of retaining the centrifugal force.

Int. 14. To avoid misunderstanding, I will ask you what you understand by "a bucket or float having a discharge line extending from the crown at its inner edge downward to the lower outer edge of the wheel"?

(Question objected to as incompetent and inadmissible.)

Ans. For the purpose of getting the inward and downward discharge and combined between.

Int. 15. Does or does not the model Exhibit 2 show a discharge line of the kind referred to in the last question?

(Question objected to for the same reasons as to int. 14.)

Ans. It does.

Int. 16. At the expense of repetition, I will now ask you whether or not the wheel made for David Fisher in 1837 was, in the respect of the discharge line of the floats, identical with Exhibit 2?

(Question objected to for the same reasons as to int. 4, and because leading.)

Ans. It was.

Int. 17. For what purpose was the wheel made in 1837 used?

Ans. When it was first made, for carding wool and cloth-dressing; the latter part of the time it was used it was for a carpenter-shop, saws, etc.

Int. 18. For how long a time was the wheel in question used in all?

Ans. Three or four years.

50 Int. 19. Under what head of water?

Ans. Twelve feet.

Int. 20. State whether, when the wheel was in use, the water set back in the flume to the height of the head given.

Ans. It did.

Int. 21. What was the character of the wheel in the point of efficiency?

Ans. Very good.

Int. 22. Had you ever seen a wheel combining the inward and downward and intermediate discharges before this time—1837?

(Objected to as incompetent and inadmissible.)

Ans. I never had.

Int. 23. When, if at all, did you next make a wheel having a crown, band, and floats, the latter having discharge lines extending from the crown downward and outward to the lower outward edge of the wheel, as shown in Exhibit 2?

(Question objected to for the same reasons as to int. 22.)

Ans. In 1841.

Int. 24. For whom was the last wheel constructed?

Ans. The same David Fisher.

Int. 25. Have you caused a model of this wheel to be prepared from drawings made by you? And, if so, please produce the same.

(Question objected to for the same reasons as to int 3.)

Ans. I have, and here produce it.

(Model produced and marked Exhibit 3, E. E. M., com'r.)

Int. 26. Compare Exhibit 3 with the wheel made by you for David Fisher in 1841.

(Question objected to for same reasons as to int. 4.)

Ans. It is a true representation of it.

Int. 27. State whether or not it represents the proportions as well as the construction and principles of said wheel.

(Question objected to for the same reasons as to int. 4, and because leading.)

Ans. It does.

Int. 28. What was the size of the second Fisher wheel—that is, the diameter?

51 Ans. Twenty-four inches.

Int. 29. What was the height of the floats between the under surface of the crown and the upper edge of the band?

(Question objected to as implying facts neither proved nor admitted.)

Ans. Eight inches.

Int. 30. Please describe the last wheel referred to, without reference to the model, that is, the 1841 two-foot wheel, commencing with the

centre and passing outward and downward, and describing each part as you proceed.

(Question objected to because it is claimed that the desired answer, in whole or part, has been already indicated to the witness by previous questions, leading or otherwise incompetent.)

(Counsel for respondent explains that the witness has already sworn that the model was made from drawings prepared by him, and the object of the question is to show the competency of the witness as a person acquainted with the manufacture of water-wheels.)

Ans. The centre is a concave, running on a convex piece of wood; it was four inches and a half from that to the outside edge of the shaft, making the diameter of the shaft nine inches, the outer rim or crown being five inches wide; there were six arms reaching from the shaft to the outer surface of the wheel six inches wide and two inches thick, the crown being bolted to them on the under side of them, the buckets being bolted to the under side of the crown, reaching down on a straight line eight inches to the band, that part of the bucket being of a scroll concave, the inner edge reaching back of the outer edge, the lower end of the bucket, which forms a quarter of a circle from a perpendicular line on the inner edge, the lower edge being on the same radius line of the inner edge of the perpendicular part, the band extending from the perpendicular part to the lower edge of the horizontal part of the buckets for the purpose of sustaining the buckets.

Int. 31. How long was this wheel in use, and for what purpose?

Ans. It was for running back a saw-mill carriage and driving a circular saw and jig saw, also turning works, taking the place of the other wheel, the wheel represented by Exhibit 2, when the building was torn down.

52 Int. 32. Please explain a little more fully the matter referred to in your last answer, about the building being torn down.

Ans. The building that the first wheel was in was rendered useless by a freshet, and the carpenter's shop was moved into the saw mill where the second wheel was.

Int. 33. Was the second wheel built before or after the freshet referred to?

Ans. After.

Int. 34. What was the character of this wheel in point of efficiency?

Ans. Very good.

Int. 35. How long was it used, to your knowledge?

Ans. One year.

Int. 36. Why have you no further knowledge as to the length of its use, and what was its condition as to use or disuse when you last knew of it?

Ans. I went down to Worcester, Mass., and did not see anything more of it. When I left the wheel was in full operation, and not all the machinery that was connected with the other wheel was connected with it.

Int. 37. From what direction was the water pitched into this wheel, and under what head was it used?

Ans. It was pitched in on a horizontal line, the outer edge of the spout at right angles with the radius line; ten feet head.

Int. 38. Why was the first head twelve feet and this ten feet?

Ans. Because the second wheel was up stream farther and we could not get down to twelve feet; could not lower the wheel without blasting the rocks more than we thought necessary.

Int. 39. State whether or not you made a third wheel containing a

crown, band and floats, the floats having discharge-lines extending from the crown on their inner edge downward and outward to the outer edge of the wheel; and, if so, when?

(Question objected to as leading, so far as relates to description of the wheel.)

Ans. I did make another, being the third wheel of that description, in 1850.

Int. 40. State in general for whom the wheel was made, of what
53 material, of what size, under what head, and how long it worked; and if it differed at all from the wheels described, state in what respect.

(The last inquiry objected to because the thirty-ninth question suggested the description desired.)

Ans. It was built for Joshua Spear and Samuel Williams, of Hartland, Vermont, of wood and iron; was a twenty-four inch wheel; worked under eleven feet head, and I am not able to say how long it worked, but to my knowledge it worked five years; it differed from Exhibit 3 in the respect that the arms were below the crown extending to the outer surface of the wheel; the convex part of the bucket was flattened by cutting it away, and the arm was fastened thereto, its end being worked off to conform to the curve of the outer edge of the bucket.

Int. 41. How many buckets and how many spokes or arms were there in this wheel of 1850? Explain fully the relation of buckets and spokes.

Ans. There were twelve buckets and six arms; that is, there was a bucket on each arm, and an alternate bucket between each arm, fastened to the crown and connected all together at the bottom by an iron band.

Int. 42. What was the thickness of each arm?

Ans. One inch thick.

Int. 43. State whether the placing of the spokes on the under side of the crown closed up any portion of the discharge lines of the buckets.

Ans. It did not.

Int. 44. For what purpose was this wheel used?

Ans. For running back a saw-mill carriage.

Int. 45. State whether or not it worked successfully.

Ans. It did.

Int. 46. Have you given all the respects in which it differed from Exhibit 3?

(Question objected for same reason as to int. 30.)

Ans. I have.

Int. 47. What was your object in making this difference of construction?

54 Ans. Cheapness of construction.

Int. 48. Did any person assist you in the construction of this wheel? And, if so, give his name.

Ans. No one assisted in making it, but Mr. Sumner B. Small assisted me in putting it in.

(Counsel for the defendant place in evidence a drawing, which is marked Exhibit 4, E. E. M., Commissioner.)

(Counsel for the complainant objects to the admission of the drawing as incompetent, irrelevant, and inadmissible.)

Int. 49. Look at Exhibit 4, now placed in evidence, and state if you know who made the drawing thereof.

Ans. I made it myself.

Int. 50. When and where did you make it?

Ans. I made it in 1850, in Hartland, Vt.

Int. 51. When did you make it relatively to the making of the last wheel of which you have testified?

Ans. Soon after I got that wheel running.

Int. 52. In this drawing, Exhibit 4, what is represented?

Ans. I intended to represent a turbine water-wheel. It represents the wheel and the conducting of the water to the wheel, gates, etc.

Int. 53. From what direction does the water enter the wheel?

Ans. From the outside, at right angles to the radius line.

Int. 54. What is represented in the principal drawing by the numerous lines drawn on radii?

Ans. The downward and the partially inward discharge of the buckets.

Int. 55. What is represented by the curved lines which bound the radial lines last referred to in the direction of the centre of the wheel?

Ans. The lines of the perpendicular part of the bucket.

Int. 56. What by the space between the two concentric rings which bound the lines mentioned in the last question?

Ans. The crown of the wheel.

Int. 57. Why do the curved lines spoken of in int. 55 extend outward farther than the straight lines mentioned in int. 54?

Ans. To show the band around the bottom of the wheel.

Int. 58. Is there any other portion of Exhibit 4 which exhibits the band? And if so, point it out.

Ans. It is shown in vertical cross-section on the drawings in the upper corners of the exhibit.

Int. 59. How did the wheel made by you for Spear & Williams in 1850 compare with Exhibit 4, as you have explained it, in respect to crown, band, and floats?

Ans. The crown band is the same; the floats or buckets were continued back farther in the drawing than they were in the wheel, the floats of the Spear & Williams wheel being in this respect like Exhibit 3.

(Counsel for defendant introduces drawing, which is marked Exhibit 5, E. E. M., Commissioner.

The introduction of this drawing objected to as incompetent, irrelevant, and inadmissible by complainant's counsel.)

Int. 60. Look at defendants' exhibit, Exhibit 5, and state if you know who made the same.

Ans. I made it.

Int. 61. When and where did you make the drawing, Exhibit 5?

Ans. In Hartland, Vt.; in 1859.

Int. 62. State generally what construction of a wheel, so far as concerns crown, band, and floats, is represented therein.

Ans. The crown and band are the same as Exhibit 4, Exhibit 3, and Exhibit 2; the inner edge of the bucket extends backward farther, is a longer plane.

(Defendant produces drawing marked Exhibit 6, E. E. M., Commissioner.

The complainant objects to its introduction as incompetent, irrelevant, and inadmissible.)

Int. 63. Look at Exhibit 6, and state if you know who made the same; and if so, by whom, and when, and where was it made?

Ans. I made it in the city of Newark, N. J., in 1861.

Int. 64. In whose hand is the writing on Exhibits 4, 5, and 6, if you know?

Ans. Mine.

Int. 65. I notice that on Exhibit 4 a portion of the writing has apparently been at some time erased; can you explain the appearance?

56 Ans. I cannot. I have no recollection of anything of that kind being done.

Int. 66. In whose hand are the words "March, 1850"?

Ans. In my hand; all the words are in my hand except what the commissioner has put there to-day.

Int. 67. If any alteration was made by you, which you say you do not recollect, how long ago must it have been made?

(Objected to as asking for an opinion or conclusion of the witness resulting from undescribed premises.)

Ans. It must have been done about the time I made it, or when I made it. I have done nothing with it since.

Int. 68. Have you any other means of giving the date of this drawing, Exhibit 4; and if so, what?

Ans. I have; I know that I made it right after the Spear & Williams wheel was running.

Int. 69. Are David Fisher, Joshua Spear, or Samuel Williams, of whom you have spoken, any of them alive?

Ans. They are not.

Int. 70. When did you know for the first time that any person other than yourself claimed to have made a wheel having a crown above the floats, a band about the lower outer edges of the floats, and floats having discharge lines extending from the crown at their inner edges downward and outward to the band, as shown in Exhibits 1, 2, 3, 4, 5, and 6?

Ans. Something like a year or a year and a half ago I saw the "Climax wheel" in New York City.

Int. 71. Who made the identical wheel, Exhibit 1?

Ans. I made it myself, with my own hands.

Int 72. How many other wheels have you made from time to time of the construction of the various models, Exhibits 1, 2, and 3, excepting those you have already described?

Ans. Eight, including Exhibit 1; seven besides it.

Int. 73. State whether or not, in making any of the wheels referred to, you received any assistance from any knowledge or information of the invention or inventions of any other party or parties than yourself, so far as concerned the crown, band, and floats?

57 Ans. I have not.

Int. 74. Of the seven wheels referred to in your answer to int. 72, what was the diameter of the largest?

Ans. Thirty-six inches.

Cross-examination by JOHN S. ABBOTT, the counsel for the complainant:

(The counsel for the complainants state that they do not intend to waive any objections heretofore noted by propounding questions relating thereto, but all such questions noted "de bene" are proposed provisionally.)

Cross-int. 75 (de bene). Please examine Exhibit 4 and state when the writing commencing with the word "Hartland" and ending with the word "Stowe" was made.

Ans. I do not know of any other time except at the date.

Cross-int. 76 (de bene). Will you swear that writing was made in 1850?

A. Yes, sir.

Cross-int. 77 (de bene). Was it made at the same time that the drawing was made?

Ans. When the drawing was finished the writing was attached to it.

Cross-int. 78 (de bene). Have you a distinct rec'llection of making the writing referred to immediately after and on the same day when the drawing was completed?

Ans. I have not, sir; I could not say positively that it was the same day.

Cross-int. 79 (de bene). Have you a distinct recollection of the time when that writing was made?

Ans. I have not, sir; within a few days.

Cross-int. 80 (de bene). Can you state with certainty in what month it was made?

Ans. I cannot, any more than the fact of its being there.

Cross-int. 81 (de bene). Can you state with certainty in what year that writing was made excepting from the fact that a year is a part of the writing?

Ans. In no other ways than in connection with the drawing.

58 Cross-int. 82 (de bene). Please examine the word "March" and the figures "1850," being a part of said writing, holding the same if needful to the light at the window, and state whether you can readily discover that something else was first written under that word and those figures and erased.

Ans. It has the appearance of something else being scratched out, but I cannot discover what it is; the paper is thinner, and the light shines through it.

Cross-int. 83 (de bene). Please examine the whole of said writing carefully, by the light at the window if needful, and then say whether the word "March" and the figures "1850" and the abbreviated word "Vt." are not apparently made with different ink and different pen from the rest of that writing.

Ans. The ink of those words and figures seems to show a purplish cast, but I see no sign of its being written with two different pens.

Cross-int. 84 (de bene). By your last answer you mean to be understood, I suppose, that the ink of the word "March" and of the figures "1850" and of the abbreviated word "Vt." does appear to be different from the ink in the rest of said writing. Do you mean to be so understood?

Ans. I do.

Cross int. 85 (de bene). Have you a distinct recollection, or any recollection, when the erasure referred to was made, and when "Vt.," "March," "1850," written, as you say, apparently in different ink from the rest of said writing, was made?

Ans. I have no recollection when it was made.

Cross-int. 86 (de bene). What was done with it immediately after those words and figures were made, and where has it been since?

(Objected to, as presupposing that the witness has a recollection when the words and figures in question were made.)

Ans. I had a private slip, or apartment, in my chest. I do not know of any other time when those words were made except when the rest were made. When I left my tools in Hartland I put my drawings in the bottom of my trunk. I came to Newark, N. J., in August,

59 1860; there I purchased an old case of drawers and put my drawings in the bottom drawer; there they remained until the National Water-Wheel Company's agent called on me. After that I took them all out of the drawer and looked them over, and fetched them here just as I took them out of the drawer.

Cross-int. 87 (de bene). After said words and figures, namely, "Vt.," "March," "1850," were made, or after the drawing was made (I mean

Cross-int. 78 (de bene). Have you a distinct rec'llection of making the writing referred to immediately after and on the same day when the drawing was completed?

Ans. I have not, sir; I could not say positively that it was the same day.

Cross-int. 79 (de bene). Have you a distinct recollection of the time when that writing was made?

Ans. I have not, sir; within a few days.

Cross-int. 80 (de bene). Can you state with certainty in what month it was made?

Ans. I cannot, any more than the fact of its being there.

Cross-int. 81 (de bene). Can you state with certainty in what year that writing was made excepting from the fact that a year is a part of the writing?

Ans. In no other ways than in connection with the drawing.

58 Cross-int. 82 (de bene). Please examine the word "March" and the figures "1850," being a part of said writing, holding the same if needful to the light at the window, and state whether you can readily discover that something else was first written under that word and those figures and erased.

Ans. It has the appearance of something else being scratched out, but I cannot discover what it is; the paper is thinner, and the light shines through it.

Cross-int. 83 (de bene). Please examine the whole of said writing carefully, by the light at the window if needful, and then say whether the word "March" and the figures "1850" and the abbreviated word "Vt." are not apparently made with different ink and different pen from the rest of that writing.

Ans. The ink of those words and figures seems to show a purplish cast, but I see no sign of its being written with two different pens.

Cross-int. 84 (de bene). By your last answer you mean to be understood, I suppose, that the ink of the word "March" and of the figures "1850" and of the abbreviated word "Vt." does appear to be different from the ink in the rest of said writing. Do you mean to be so understood?

Ans. I do.

Cross int. 85 (de bene). Have you a distinct recollection, or any recollection, when the erasure referred to was made, and when "Vt.," "March," "1850," written, as you say, apparently in different ink from the rest of said writing, was made?

Ans. I have no recollection when it was made.

Cross-int. 86 (de bene). What was done with it immediately after those words and figures were made, and where has it been since?

(Objected to, as presupposing that the witness has a recollection when the words and figures in question were made.)

Ans. I had a private slip, or apartment, in my chest. I do not know of any other time when those words were made except when the rest were made. When I left my tools in Hartland I put my drawings in the bottom of my trunk. I came to Newark, N. J., in August,

59 1860; there I purchased an old case of drawers and put my drawings in the bottom drawer; there they remained until the National Water-Wheel Company's agent called on me. After that I took them all out of the drawer and looked them over, and fetched them here just as I took them out of the drawer.

Cross-int. 87 (de bene). After said words and figures, namely, "Vt.," "March," "1850," were made, or after the drawing was made (I mean

the drawing Exhibit 4), did you put it in the private slip or apartment named in your last answer?

Ans. I think it might have been till June, when I packed up to go to Plattsburg, New York.

Cross-int. 88 (de bene). What might have been till June?

Ans. That it lay about the house, on the table or somewhere else, until I packed my chest; I cannot recollect.

Cross-int. 89 (de bene). Did you put that Exhibit 4 in the slip or apartment of your chest named in your answer to cross-int. 86?

Ans. I did.

Cross-int. 90 (de bene). How long did it remain there after it was so placed?

Ans. Nearly nine years.

Cross-int. 91 (de bene). How soon after the drawing was completed did you put it in that slip or apartment?

Ans. I cannot tell exactly.

Adjourned to July 31, 1875, 8 a. m.

Cross-examination of Mr. STOWE continued.

Present: Counsel as before.

JULY 31, 1875.

Cross-int. 92 (de bene). State how soon, according to your best recollection, after the drawing on Exhibit 4 was completed, you placed it in the slip or apartment aforesaid.

Ans. Some time between that and June in the same year.

Cross int. 93 (de bene). I understand, from your answers to cross ints. 89 and 90, that after you placed said Exhibit 4 in said slip or apartment, it was not taken out until about nine years thereafter. Do you intend to be so understood?

Ans. I do not.

Cross-int. 94 (de bene). Then state what you do intend to be
60 understood by your answer to said cross-interrogatories, in which you stated that it remained there nearly nine years.

Ans. I mean to state that that was the place of keeping for it. I do not know but that it was taken out a hundred times. I don't recollect about it.

Cross-int. 95. Do you recollect of taking it out at all during that period of about nine years?

Ans. Not positively; I do not.

Cross-int. 96. You have spoken of going to Worcester. When was that?

Ans. September, 1842.

Cross-int. 97. How long did you remain in Worcester?

Ans. About a year, at that time.

Cross-int. 98. In what business were you then engaged there?

Ans. Carpenter business, that year.

Cross-int. 99. When did you leave Worcester, and to what place did you go?

Ans. I left Worcester in 1843, I think, in October, and went to Grafton, Mass.

Cross-int. 100. How long did you remain in Grafton, and in what business were you engaged there?

Ans. I remained there about three months, sick with the rheumatic fever.

Cross-int. 101. To what place did you then go?

Ans. To Rogersonville, in Uxbridge, Mass.

Cross-int. 102. How long did you remain there, and in what business engaged?

Ans. I remained there about six months, and was engaged in repairs in a cotton mill.

Cross-int. 103. What kind of repairs?

Ans. Repairing machinery.

Cross-int. 104. What part did you take or perform in such repairs?

Ans. I worked at iron and wood both, as it became necessary.

Cross-int. 105. Employed as a workman or laborer?

Ans. I was employed as a mechanic.

Cross-int. 106. To what place did you then go?

61 Ans. Went from there to New England Village, in Grafton, Mass.

Cross-int. 107. How long did you remain there, and how were you employed?

Ans. I remained there till December, 1844; I was employed on cotton machinery—building new machinery.

Cross-int. 108. As a hired mechanic, I suppose?

Ans. Yes, sir.

Cross-int. 109. To what place did you then go?

Ans. To Worcester, to Bradley & Rice's car shop.

Cross-int. 110. How long did you remain in Worcester, and in what business engaged?

Ans. I remained in Worcester until April 1, 1845, engaged in car business.

Cross-int. 111. To what place did you then go?

Ans. To Holbrook's, in Northbridge, Mass.

Cross-int. 112. How long did you remain there and in what business employed?

Ans. I remained there until February, 1848, in millwright business and machinery.

Cross int. 113. Describe the kind of millwright business that you were there engaged in.

Ans. I had charge of finishing off a new mill and putting in all the machinery. I also put in five Howd or United States wheels.

Cross-int. 114. For whom did you superintend this work?

Ans. For Sylvanus Holbrook.

Cross-int. 115. What kind of a mill was it?

Ans. A cotton mill.

Cross-int. 116. Were you the sole supe intendent of the work?

Ans. No, sir. I was subject to the superintendent of the mill, of the other mill which was running.

Cross-int. 117. What kind of a wheel was the Howd wheel?

Ans. A centre vent, turbine.

Cross-int. 118. When did you first know or hear of that wheel?

Ans. When Mr. Holbrook caused them to be brought there; the time was in 1845.

62 Cross-int. 119. Did you ever know or hear of a centre vent wheel before that time?

Ans. None except those that I made in 1837 and 1841; they were centre vent and downward combined.

Cross-int. 120. To what place did you go from Northbridge?

Ans. I went to Windsor, Vt.

Cross-int. 121. How long did you remain there, and by whom and how employed?

Ans. I remained there a little over a year, and was employed by Robbins & Lawrence in the car business.

Cross-int. 122. To what place did you then go?

Ans. I went to Hartland, Vt.

Cross-int. 123. How long did you remain there, and by whom and how employed?

Ans. I remained there a little over a year, and was employed by Spear & Williams in building a saw mill the latter part of the time.

Cross-int. 124. To what place did you then go?

Ans. I went to Claremont, N. H.

Cross-int. 125. How long did you remain there, and by whom and how employed?

Ans. I remained there from June to November, in 1850. I was employed by a man by the name of Hall—I do not recollect his name now—in the millwright business.

Cross-int. 126. To what place did you then go?

Ans. Went to Windsor to work, but still lived in Cornish. I lived in Cornish while I worked in Claremont and Windsor.

Cross-int. 127. How long and for whom did you work in Windsor?

Ans. I worked in Windsor from November till the next April, in 1851, and was engaged in the car business for Robbins & Lawrence.

Cross-int. 128. To what place did you then go?

Ans. I went to Hartland, Vermont.

Cross-int. 129. How long did you remain there, and in what business were you engaged, and for whom?

Ans. I remained there for a little over a year—from April to June, over a year—and was engaged in carrying on a small farm and
63 running a saw mill which I hired. I hired both the farm and the mill of Spear & Williams.

Cross-int. 130. To what place did you then go?

Ans. Plattsburg, New York.

Cross-int. 131. How long did you remain there, and in what business were you engaged, and for whom?

Ans. I remained there about three years. I was employed having charge of car building and railroad repairs. I was employed building cars by Hartwell, Winslow & Co., and afterwards I was employed by Joseph Kirk, in car building and repairs also.

Cross-int. 132. To what place did you go from Plattsburg?

Ans. Wheelock, Vermont.

Cross-int. 133. How long did you remain there, how employed, and by whom?

Ans. I remained there till 1857, in June. I was in my own employment. I had a planing mill and saw mill.

Cross-int. 134. Did you hire or take lease of the planing and saw mill; and if so, from whom?

Ans. I owned it.

Cross-int. 135. To what place did you then go?

Ans. St. Johnsbury, Vermont.

Cross-int. 136. How long did you remain there, and by whom and how employed?

Ans. I remained there till April, 1859. I was employed by Luke Buzzard, in millwright and machine business.

Cross-int. 137. To what place did you then go?

Ans. Hartland, Vermont.

Cross-int. 138. How long did you remain there, and how and by whom employed?

Ans. I remained there till August, 1860, and I was employed in the millwright business, the first part of the time by Thomas Cobb, and second by West Labarie, and third part of the time by Harris Miller.

Cross-int. 139. To what place did you then go?

Ans. Newark, New Jersey.

Cross-int. 140. And have you lived there since that time?

64 Ans. All excepting four years, when I was out in an adjoining town.

Cross-int. 141. When and for whom was the first of the eight wheels mentioned in your answer to the seventy-second interrogatory made?

Ans. In 1873. I made it for myself. I was carrying on business for myself at the time; it was during the four years I was residing out of Newark. I sold it to the Boonetown Iron Works; it was built for them, to their order.

Cross-int. 142. When did you receive from them the order for the wheel?

Ans. Some time in the fall of 1873.

Cross-int. 143. What was the size of the wheel, and of what materials made?

Ans. Twenty-four-inch wheel; made of iron.

Cross-int. 144. When was the wheel delivered, and how much was paid for it?

Ans. It was delivered some time that fall; I cannot tell when. Two hundred and seventy-five dollars was the price of it.

Cross-int. 145. Was that wheel in all respects (excepting its size) identically like Exhibit 1?

Ans. It was, except material.

Cross-int. 146. Where are those works situated? And give the name of the man who ordered the wheel.

Ans. The works are about twenty miles from Newark, in Morris County, and James Esten, superintendent of the works, ordered the wheel for the works.

Cross int. 147. When did you last see that wheel?

Ans. I have not seen it since it left the shop.

Cross-int. 148. State when you made each of the remaining seven wheels above referred to in the order of time when they were made, give the size of each and for whom each was made.

Ans. The next wheel was made in 1874 for Dr. Flagler of Morristown, New Jersey, was a thirty-inch wheel; the next was made in 1874, towards the end of the year, was a twenty-four-inch wheel; was made for the Boonetown Iron Works. These are all I made while carrying

65 on business for myself. The next was a twenty-four-inch wheel, made and sold to Mr. Syndell, at Little Falls, New Jersey, and was made in the first part of this year. The next is a thirty-six-inch wheel, and was made for Mr. Potter, of Bloomfield, New Jersey, also in the early part of this year. The next was a twenty-four-inch wheel, made for Dr. Henderson, of Milburn, New Jersey, just finished. I have omitted one, which was a twenty-four-inch wheel, and made in 1874, for George B. Budd, of Chatham, N. J. This one I made when I was carrying on business for myself. Exhibit 1 was made this month. All these wheels except the four I made while carrying on business for myself were made as a mechanic in the employ of E. W. Roff, of Newark, N. J.

Cross-int. 149. Were each of these six wheels named in last answer (excluding the last named) identically like Exhibit 1, excepting their size?

Ans. All the same except the material, there being more brass in Exhibit 1 than in them.

Cross-int. 150 (de bene.) Where did you obtain the paper of Exhibit 4?

Ans. I do not recollect positive; I do not know of any other place that I could get it, but Windsor, Vt.

Cross-int. 151 (de bene.) Refer to Exhibit 5, and state whether you have any means of determining when the drawing thereon was made, excepting by referring to the date thereof.

Ans. I have.

Cross-int. 152 (de bene.) What means?

Ans. I put in a wheel for Thomas Cobb, and made this to show him the improvement of the downward and centre discharge; he objected and I made him a centre vent wheel.

Cross-int. 153. Please give the name and residence of said Cobb, and the time when you put in said wheel for him.

Ans. Thomas Cobb, Hartland, Vt.; about June, 1859.

Cross-int. 154 (de bene.) When was the pencil writing, commencing with "this" and ending with "Stowe," made on said Exhibit 5?

Ans. I have no knowledge of any other time of making it except when I made the drawing.

66 Cross-int. 155 (de bene.) Can you testify that it was made at that time, and do you so testify?

Ans. I do not recollect of ever putting it there positively.

Cross-int. 156 (de bene.) It is your handwriting, is it not?

Ans. It is.

Cross-int. 157. Examine Exhibit 6, and state when the pencil writing, commencing with "this" and ending with "Stowe," was made.

Ans. I cannot tell anything about it, only when I make a drawing I put my name to it and the place. I do not recollect of doing it, or on any of them.

Cross-int. 158 (de bene.) The writing referred to is yours, is it not?

Ans. It is, sir.

Cross-int. 159 (de bene.) Was or not the paper of Exhibit 5, when you made the drawing thereon, untorn and unsoiled?

Ans. I could not say, but I suppose it was. I generally make it on new paper.

Cross-int. 160 (de bene.) I notice that it is badly soiled now, particularly the lower part. I notice also that the said pencil-writing in several places is over soiled spots. Please examine the same carefully by the light of the window, if needful, and state whether said pencil-writing was not evidently made after said spots were on the said paper and over the same. Look particularly at the letter "u" in "June," and the upper part of the "t" in "Vt.," and the crossing of said "t."

Ans. I cannot tell whether the soiling is first or the writing first by the appearance.

Cross-int. 161. Have you any drawing made in 1837 or previously, of the wheel which you testified you made in that year?

Ans. I have not.

Cross-int. 162. Did you ever have any drawing which was made in 1837, or previously, of that wheel?

Ans. I never did.

Cross-int. 163. Did you ever see any drawing of that wheel which was made in 1837, or previously, or know of any such drawing?

67 Ans. I never did.

Cross-int. 164. Have you any memoranda or minutes or descrip-

tion or statement of dimensions made in 1837, or previously, of or respecting the wheel you have testified you made in 1837?

Ans. I have not.

Cross-int. 165. Did you ever have or see such memoranda, minutes, statement, or description, which was made in 1837 or previously?

Ans. I never did.

Cross-int. 166. Did you ever have or see any such memoranda, minutes, statement, description, plan or drawings of or relating to said 1837 wheel, which was made in 1850 or previously?

Ans. None except Exhibit 4, which has some points in it relating to the 1837 wheel, that is, the central and downward discharge.

Cross-int. 167. Did you ever have or see any such memoranda, minutes, statement, description, plan or drawings of or relating to said 1837 wheel, which was made in 1849 or previously?

Ans. No, sir; I never saw any.

Cross-int. 168. Did you ever have or see any plan or drawings, or any statement, memoranda or description of or relating to the wheel which you have testified you made in 1841, during or prior to the year 1849?

Ans. I never did.

Cross-int. 169. Where did your father reside in the year 1837?

Ans. In the town of Halifax, Vt.

Cross-int. 170. Were you boarding at home at the time when you were making the 1837 wheel?

Ans. I made it at my home at my father's house. When I worked anywhere, I boarded where I worked.

Cross-int. 171. Question repeated.

Ans. No, sir; I was boarding with David Fisher.

Cross-int. 172. In what business was your father engaged at that time?

Ans. He was a farmer.

Cross-int. 173. Did you do the mechanical work in constructing the said 1837 wheel?

Ans. I designed it, and Mr. Fisher and I made it together.

68 Cross-int. 174. Who actually made the buckets of that wheel?

Ans. I made them.

Cross-int. 175. Of what kind of wood were they made?

Ans. Yellow birch.

Cross-int. 176. In what form or condition was the wood when you commenced upon it, for making a bucket.

Ans. Sawed out somewhere about twelve inches by six inches. I cannot exactly recollect the precise dimensions.

Cross-int. 177. State the size according to your best recollection.

Ans. It might have been eight inches thick, and perhaps more; I cannot precisely tell.

Cross-int. 178. With what tools or implements did you form the bucket?

Ans. With the ax, adze, jack-plane and hand-saw.

Cross-int. 179. What had you previously been engaged in, and where?

Ans. I had previously been engaged in farming and some mechanical work. I was always engaged in mechanical work when I could get any.

Cross-int. 180. What mechanical business had you previously done, and where and for whom?

Ans. I had made ox-carts, ox-yokes, cart-wheels, ox-sleds, and framed some buildings when I was to work under my father.

Cross-int. 181. Where was the 1837 wheel placed in relation to the shop you have spoken of?

Ans. Under it.

Cross-int. 182. Prior to your making the 1837 wheel had you worked or been away from home? If so, state generally and as acurately as you can, for how long a time.

Ans. I never was; never away from home very long at a time. I worked away one fall for Jesse Spurr, making cider mills while the business lasted. I also worked for Mr. David Fisher, fixing and repairing around his mill,—odd jobs. Helped Mr. Spurr make several cider mills when working for him, presses and grinding parts.

Cross-int. 183. What kind of a wheel did said Fisher use prior to 1837, in the place where 1837 wheel was set?

69 Ans. What is called a tub wheel.

Cross-int. 184. How was the water conveyed to that tub wheel?

Ans. In an open spout from the flume on to the top of the buckets discharging downwardly.

Cross-int. 185. When your 1837 wheel was set, was the water which drove it taken from the same place in the flume spoken of in your last answer?

Ans. It was.

Cross-int. 186. How soon after the freshet, which injured the said shop as you stated, were you at that place?

Ans. I think I was around the next day.

Cross-int. 187. Did the freshet carry the wheel off or destroy it?

Ans. It did not.

Cross-int. 188. What was done with the wheel?

Ans. The building stood in such a precarious condition that it was unsafe, and consequently was thrown down. It was tipped over bodily into the river, and one end of the shaft was thereby broken, and the wheel destroyed.

Cross-int. 189. What machinery was driven or propelled by that wheel at one and the same time to your knowledge?

Ans. When it was first fixed it drove wool-carding and cloth-dressing machinery; after that the building was used for a carpenter's shop; the wool-carding and cloth-dressing machinery was moved out, and the wheel was connected with circular saws, etc. I was not acquainted with the cloth-dressing business. After the carpenter-shop machinery was connected with the wheel it drove two circular saws and a matching machine at one and the same time to my knowledge.

Cross-int. 190. For what were those circular saws used and of what size were they?

Ans. There was one splitting saw which I think might be fourteen or fifteen inches diameter and the other was a cutting off saw twenty or twenty-four inches and was used a great deal in cutting wood, fire wood.

Cross-int. 191. When that wheel was in operation how many revolutions per minute did it make?

70 Ans. I have tables by which I can tell, but have no recollection of them so that I can tell from my head.

Cross-int. 192. Where was the wheel which you say you made in 1841 placed for operation as compared with the place where the wheel of 1837 ran?

Ans. About forty feet farther up stream and about two feet higher as to the fall on account of the rocks.

Cross-int. 193. Was the water that propelled this 1841 wheel taken in a spout from the same place in the flume as it was to propel the 1837 wheel?

Ans. No, sir; nor from the same flume.

Cross-int. 194. From what flume was it taken and how far was it carried in a spout and what was the size of the spout?

Ans. From a new flume built farther up stream some forty or fifty feet from where the old flume was, and the spout where it discharged on the wheel was four inches by eight, parallel up and down all the way to the flume, and the end that was in the flume was probably fifteen inches by eight, that is, it was spread on the flume end horizontally to fifteen inches. This spout was from six to eight feet long.

Cross-int. 195. And all the water to drive this wheel was conducted through that spout, was it not?

Ans. It was.

Cross-int. 196. Did this spout conduct the water on to the wheel at right angles with the radii of the wheel and at one point only?

Ans. The outer side of the spout was at right angles with the radii of the wheel, the taper was on the inner side towards the centre of the wheel. The water was conducted on to the wheel at right angles with the radii of the wheel, and as nigh upon one point as a stream four inches thick could be applied.

Cross-int. 197. Was the water conducted on to the wheels of 1837 and 1850 that you have spoken of in substantially the same manner as on to the wheel of 1841, and described in your last answer? And please give the size of the spout for each.

Ans. It was not. On the 1837 wheel it was, except that the spout was pitched down a little and did not run on a level. On the 1850 wheel the spout was also pitched down a little, and the gate to
71 the spout was in the flume, while in the others the gates were in the mouths of the spouts. The spout of the 1850 wheel was the same size as that to the wheel of 1841, but the spout of the 1837 wheel was about twelve inches by six inches at the mouth, and twelve by twenty at the other end. The lengh of the spout to the 1837 wheel was about ten feet; the length of the spout of the 1850 wheel was five or six feet.

Cross-int. 198. Were either of these spouts or wheels submerged, in whole or in part; and, if in part, how much?

Ans. They were not.

Cross-int. 199. Referring to int. 31, and the answer thereto, please state whether the 1841 wheel drove allof that machinery at one and the same time.

Ans. It did.

Cross-int. 200. Did it also, at the same time, drive another circular saw in addition to the one named in answer to int. 31 and inadvertently omitted by you in such answer, as now just orally suggested by you?

Ans. It did.

Cross-int. 201. Are the two circular saws, just referred to by you as driven by the 1841 wheel, the same saws as were driven by the 1837 wheel?

Ans. They were, to my own knowledge; for I helped move them out of the old mill and into the new.

Cross-int. 202. When the aforesaid machinery (I mean the saws, etc.) were being driven at one and the same time, as stated by you, were they doing their usual and appropriate work?

Ans. They were.

Cross-int. 203. What machinery was driven at one and the same time by the wheel which you testify you made in 1850?

Ans. It only run the carriage back, to my knowledge.

Cross-int. 204. And you saw it operate, I suppose, did you not?

Ans. I did.

Cross-int. 205. For how long a time had you personal knowledge of the running of that wheel?

Ans. I cannot remember positively, but I will say five years, at any rate.

72 Cross-int. 206. Since the wheels of 1837, 1841, and 1850, respectively, were made and put in operation, have you measured them, or either of them?

Ans. I have not.

Cross-int. 207. In your answer to cross-int. 87, you say, "The National Water Wheel Company's agent called on me." Please give the name of the agent, and state the time when he called, to which you refer in that answer.

Ans. I do not know his name; it was in April or May of this year.

Cross-int. 208. In your answer to int. 6, you state that a model, being Exhibit 2, was constructed under your direction. When was it constructed, where, and by whom?

Ans. That model was constructed by the National Water Wheel Company, under my direction. I do not know when they constructed it; I suppose, in Bristol, since last May.

Cross-int. 209. To whom, when, and where, did you give instructions or directions in relation to the making of that model?

Ans. I think to James Shepard, when I was at Bristol in May. I gave a sketch of it.

(The last phrase objected to as not responsive.)

Cross-int. 210 (de bene). When, where, and in whose presence (if any one was present) was that sketch made, and by whom was it made?

Ans. It was made in May, 1875, in Mr. Shepard's office, in Bristol, Conn., and I think in Mr. Ladd's presence, and it was made by Mr. Shepard, in my presence.

Cross-int. 211. To what Mr. Ladd do you refer, and what connection has he with the said National Water Wheel Company?

Ans. James E. Ladd, and he appears to be the superintendent of that company.

Cross-int. 212. How happened you to be at Bristol on that occasion, and how long did you remain there?

Ans. I was sent for by Mr. Ladd, of the National Water Wheel Company, and I stayed there about one day.

Cross-int. 213. Were you present during any part of the time when the model Exhibit 2 was being constructed?

73 Ans. I was not.

Cross-int. 214. When, where, and by whom was model Exhibit 3 made?

Ans. By the National Water Wheel Company, of Bristol, I suppose; I did not see it made, and it was made this present week, and I do not know where. I was not here.

Cross-int. 215. Did you give any directions as to its construction; if so, to whom, when, and where?

Ans. I did give instructions; I made a sketch in Mr. Mitchell's office last Tuesday. I gave what instructions I gave to Mr. Mitchell.

(Statement about sketch objected to as irresponsive.)

Cross-int. 216. Do you mean the Mr. Mitchell who is the solicitor for the respondent in this case?

Ans. I do.

Cross-int. 217 (de bene). What time on Tuesday did you make that sketch?

Ans. Some time about ten o'clock in the forenoon.

Cross-int. 218. Where is that sketch, so far as you know?

Ans. I do not know anything about it. I left it in Mr. Mitchell's office when I went away.

(Counsel for complainant here notifies respondent's counsel that unless the two sketches referred to by the witness shall have been produced in season for cross-examination, evidence touching the same will be objected to.)

Cross-int. 219. Was the said Mr. Ladd also at Mr. Mitchell's office Tuesday forenoon?

Ans. He was.

Cross-int. 220. And did you go there with him?

Ans. I did. I came from Bristol with him that morning.

Cross-int. 221. Did you leave also with Mr. Ladd on that day and about eleven o'clock a. m.?

Ans. I did.

Cross-int. 222. Have you been at Bristol since that Tuesday?

Ans. I have not.

Cross-int. 223. When were you last in Newark, New Jersey?

Ans. I left there last Monday, about eleven o'clock a. m.

74 Cross-int. 224. Since you left the office of Mr. Mitchell on Tuesday last, where have you been with him (meaning Ladd)?

Ans. I have been to Hartland, Vermont.

Adjourned to Aug. 2, 1875, 8 a. m.

(The remainder of the deposition of this witness, JOHN L. STOWE, was taken, by consent of parties, before J. Henry Hill, esq., U. S. commissioner, in Worcester, Mass.)

WORCESTER, *Aug.* 12, 1875.

Cross-examination by JOHN S. ABBOTT, esq., of counsel for complainant.

Cross-int. 226. State, as accurately as you can, the length and also the thickness or diameter of the shaft of the wheel which you testified to have made in 1837.

Ans. As near as I could recollect, it would be about eighteen feet in length; the diameter might have been twelve inches.

Cross-int. 227. Was the thickness of the shaft uniform, that is, the same from top to bottom?

Ans. I think the top was a little the smallest.

Cross-int. 228. What was the diameter of the top? State as accurately as you can.

Ans. It might have been ten inches; I couldn't state exactly.

Cross-int. 229. How far from the top to the point where it was of its full size?

Ans. About ten feet, I think.

Cross-int. 230. And from that point to the bottom, was it of the same size?

Ans. I think it was.

Cross-int. 231. And twelve inches in diameter?

Ans. I think that was the size, as near I as can recollect.

Cross-int. 232. Do you recollect, and was that the size?

Ans. I do not, sir; I did not put the shaft in, and never measured it. It was an old shaft.

Cross-int. 233. What was the width and what the thickness of the rim of that wheel?

75 Ans. I think that the rim was three inches—three or four I am not positive—thick; the width was about twelve inches.

Cross-int. 234. Can you not state with any more definiteness, accuracy or certainty as to the width of that rim, and thickness?

Ans. That rim of that wheel was made of two thicknesses of stuff; I can't recollect to an eighth of an inch what that thickness was. The width of the rim was governed by the original tub wheel buckets, therefore I can't recollect.

Cross-int. 235. What was the distance between the inner edge of the rim and the shaft on a radial line?

Ans. About two feet.

Cross-int. 236. What latitude do you give to the word "about" in your last answer?

Ans. Well, I'll define it, as near as I can. The inner edge of that rim was five feet, nearly; one-half of it would be two and a half feet; six inches subtracted from that leaves about two feet.

Cross-int. 237. How many buckets were there in that wheel?

Ans. Twelve.

Cross-int. 238. What was the length of those buckets from top to bottom, in a perpendicular line?

Ans. Twelve inches.

Cross-int. 239. What was the longest distance across each bucket on a horizontal line—a line at right angles with the perpendicular line—referred to in my last question?

Ans. It depends upon the direction in which that line runs. You've not got the question so I can answer it.

Cross-int. 240. Suppose a straight edge placed across the bucket from the inner to the outer edge at the widest part, on the side hollowed in, in a horizontal direction, or at right angles with a perpendicular line, when the wheel was in position for running, and you were to measure on that straight edge the distance from one side or edge of the bucket to the other side or edge of the bucket, what would that distance be?

Ans. I cannot give you a definite measurement there without a diagram, but I think about fifteen inches.

Cross-int. 241. What was the width and what the thickness of the band of that wheel? State as accurately as you can.

76 Ans. Half an inch thick, five inches wide, as nigh as I can recollect.

Cross-int. 242. What was the perpendicular distance from the lower side of the rim to the lower edge of the band?

Ans. About seventeen inches.

Cross-int. 243. Suppose a straight edge placed across one of those buckets, as described in two hundred and fortieth cross-interrogatory, and opposite to that part of the bucket which was dug out or scalloped out the deepest, what would be the distance between the inner side of the straight edge and the bucket, measuring opposite the part dug out the deepest, and measuring, also, on a line at right angles with the straight edge?

Ans. I should think about two inches.

Cross-int. 244. Was the outer edge of each of those buckets, from the rim to the upper edge of the band, on a straight line?

Ans. They were.

Cross-int. 245. Was the inner edge of each bucket, from the lower side of the rim downward to a point opposite the upper edge of the band (measuring on a horizontal line), also on a straight line?

Ans. It was not. This all from memory. I can't tell exact, but that's as nigh as I can tell.

Cross-int. 246. How far downward from the lower side of the rim was the inner edge of each bucket, on a straight line? I mean how far downward in a perpendicular direction.

Ans. Eight or nine inches.

Cross-int. 247. Which distance, eight or nine? State as accurately as you can.

Ans. Well, it was either eight or nine, or between. I couldn't place it positively.

Cross-int. 248. Suppose a straight edge placed across one of those buckets, exactly as described in two hundred and forty-third cross-interrogatory, and another straight edge placed on the opposite side of the bucket, parallel with the first straight edge, and both equidistant from the top of the bucket, how far apart would they be, measuring from the inside of one straight edge, on a perpendicular line thereto, to the inside of the other straight edge? State as accurately as you can.

77 Ans. Four or five inches.

Cross-int. 249. Can you not state that distance within an inch?

Ans. I cannot.

Cross-int. 250. Out of what material were those buckets made?

Ans. Wood.

Cross-int. 251. What kind of wood?

Ans. Yellow birch.

Cross-int. 252. In what form was the wood when you commenced to make the bucket? And state as accurately as you can the dimensions thereof.

Ans. I think it was about twelve inches wide; twelve by eight sawed.

Cross-int. 253. And what the length?

Ans. Well, it was a long timber; I can't tell the length.

Cross-int. 254. Are you certain you are accurate as to the width and thickness?

Ans. I am, as nigh as I can recollect.

Cross-int. 255. Do you know where that timber was sawed? If so, state where, and by whom.

Ans. I do. It was sawed in the mill close by when we were building, in the adjoining building to where the wheel was placed, by David Fisher and myself.

Cross-int. 256. State the length of the timber as accurately as you can.

Ans. Somewhere in the neighborhood of twelve feet, I think.

Cross-int. 257. Did you dig out, or scallop out, for the buckets before they were cut off, or afterwards, or when?

Ans. After they were cut off.

Cross-int. 258. And did you cut or take off from the back side of the buckets whatever was taken off, before or after the blocks were cut from the sawed timber?

Ans. I think it was after the blocks were cut off.

Cross-int. 259. What was the length of these blocks?

Ans. About seventeen inches.

Cross-int. 260. Do you recollect, with accuracy, the length of those blocks?

Ans. I do not.

78 Cross-int. 261. Can you give the names of any persons now living (so far as you know) who saw you when working upon those

blocks? If so, state their names and places of residence, so far as you know or are informed.

Ans. I don't know of any one.

Cross-int. 262. Did any one assist you in making the buckets? If so, who?

Ans. Mr. Fisher was the only one.

Cross-int. 263. In what way was the block placed, or how was it kept in its place when you dug it out?

Ans. Part of the time it was wedged into a key-block, as we call it; the outer part of the bucket was worked off on a form, a form placed in the inside.

Cross-int. 264. Who assisted you in setting that wheel, or in putting it in position to operate?

Ans. Mr. Fisher.

Cross-int. 265. Any other person?

Ans. No, sir.

Cross-int. 266. You have stated that the shaft of that wheel had been before used as part of a tub wheel. Did you see it when so used?

Ans. I did.

Cross-int. 267. Where?

Ans. In that place. The shaft was not moved from its place.

Cross-int. 268. And did you see the tub wheel in operation at any time?

Ans. I did.

Cross-int. 269. Driving the same carding and woollen machinery that the wheel made in 1837 afterwards drove?

Ans. I did.

Cross-int. 270. Did that shaft, when so used (I mean prior to 1837), have any arms attached to or mortised into it?

Ans. It did.

Cross-int. 271. And were the same arms continued, making a part of the 1837 wheel?

Ans. They were.

79 Cross-int. 272. And the position of the shaft and of the arms was not changed, was it?

Ans. They were not, excepting a little fitting where the rim was fitted on the under side.

Cross-int. 273. And no other change made as to the shaft and as to the arms, as used for a tub-wheel and as used for the wheel of 1837, was there?

Ans. None other.

Cross-int. 274. How many bolts were used to confine the upper end of one of the buckets of the 1837 wheel to the rim; and how far apart were they, to your best recollection?

Ans. Two bolts; five inches apart.

Cross-int. 275. Give the size and length of each bolt.

Ans. For the buckets that came between the arms the bolts were both of a length; perhaps six inches in length; might have been seven; call it seven; half-inch iron, as near as I can recollect. I don't recollect positively. All the bolts were of a length.

Cross-int. 276. What kind of bolts?

Ans. Well, I don't know what you mean by "What kind of bolts."

Cross-int. 277. How did you put the bolts in?

Ans. There was a nut let into the bucket, and the bolt screwed into it through the rim.

Cross-int. 278. How many bolts were used to confine the lower end of a bucket to the band; and were they put in in the same way?

Ans. Two wood-screws countersunk into the band and screwed into the bucket.

Cross-int. 279. How many buckets or floats did the tub-wheel have?

Ans. Twelve.

Cross-int. 280. Describe, as accurately as you can, the machinery which was driven or operated by the wheel of 1837; and whether it was all operated at one and the same time.

Ans. Well, the first was a carding machine; a wool-carding machine,
for rolls and custom work, and a picker attached; the rest was
80 machinery for dressing cloths for custom work. I am not ac-
quainted with the business, and therefore I cannot give the names of the machines, nor the numbers. I can't say whether they were all operated at the same time.

Cross-int. 281. Please give the names of any and all persons whom you ever saw operating, or assisting in the operating, the 1837 wheel, or whom you ever saw examining or looking at it, if living (so far as you know), and their places of residence at the present time, or when you last knew or heard of their places of residence.

Ans. I never knew of any one except Mr. Fisher and Mr. Willis attend to the carding and cloth-dressing business there. I am not positive whether Mr. Willis had anything to do with the wheel after I put it in there, or not; I can't remember. Mr. Fisher's place of residence, the last I heard of him, was at Halifax, Vt.; South Halifax. Mr. Willis lived at Coleraine, Mass., the last I knew of him. I have heard that Mr. Fisher was dead. I don't know whether Mr. Willis is dead or alive.

Cross-int. 282. What was Mr. Willis engaged in at Coleraine?

Ans. His father carried on the cloth-dressing and wool-carding business; and he came to Halifax, and there he carried on the cloth-dressing and wool-carding business with Mr. Fisher; how long I am not able to say. Then he went back to Coleraine, into the foundry business; and that's the last I knew of him.

Cross-int. 283. State the names of all persons (now living so far as you understand) whom you saw examining the 1837 wheel, and whom you saw operating, or assisting in operating, that wheel, when used in connection with a carpenter's shop. Also, state their respective places of residence at the present time, so far as you know or have been informed.

Ans. I don't recollect of any person that's now alive examining the wheel. It was used for a carpenter's shop by Mr. Fisher while he was building him a house; and who he had to work for him around there at that time I do not know. It stood idle for a long time after the freshet. I don't remember the year of the freshet.

Cross-int. 284. While it was used in connection with that carpenter's shop, were you not in the shop when the wheel was running? If so, who were running it at that time or times?

Ans. I saw people sawing there. I had a couple of cousins who
81 used to be in there a good deal, too. Their names were Israel
Stowe and Robert Stowe, both of Halifax—South Halifax.

Cross-int. 285. Can you not give the names of any persons whom you saw sawing there?

Ans. None others than I have. The men that he had to work on his house were all strangers to me; I didn't know them.

Cross-int. 286. In a former question, one hundred ninety-one cross, I believe, you were asked, in substance, "when that wheel was in opera-

tion, how many revolutions per minute did it make?" and you answered, in substance, "cannot tell without referring to my tables; I cannot carry it in my head; can tell by referring to my tables." Please refer to your tables, and then answer the inquiry as well as you can.

Ans. About fifty revolutions.

Cross-int. 287. Please give the power of that wheel, if you can.

Ans. I have no other means of giving the power, except by referring to the tables; so much power to such an amount of water. I never tested it.

Cross-int. 288. Give the power as accurately as you can, referring to your tables if they will aid you in answering the inquiry.

Ans. Somewhere from twenty-five to thirty horse power, as applied on this wheel. That's as nigh as I can get.

Cross-int. 289. In your testimony you have spoken of a wheel made by you in 1841. Give the number of revolutions per minute of that wheel; also its power; referring to your tables if they will aid you in answering.

Ans. About one hundred and fifty revolutions a minute. About five or six horse power.

Cross-int. 290. You have also testified about a wheel made by you in 1850; what number of revolutions per minute did that wheel make, and what was its power? You can refer again to your tables if they will aid you.

Ans. A hundred and seventy revolutions; six or seven horse power.

(Counsel for respondent here produces the two sketches called for by complainant's counsel just before the close of the testimony taken before Commissioner Marvin, to be marked Exhibit Sketch of 1837
82 Wheel, and Exhibit Sketch of 1841 Wheel, respectively, and states that the words, "Opponent's Exhibit C, George A. Gowdy, J. P.," were placed upon the exhibit in May last, when the same was offered in evidence at New Britain, Ct., in the matter of the application of John Heseltine then pending before the Patent Office for an extension of certain letters patent.

Counsel for complainant does not examine or look at "Exhibit Sketch of 1837 Wheel," nor concede that it is admissible as evidence, or that any testimony heretofore given under objection, touching it, is admissible, notwithstanding its production.)

Cross-int. 291. Please examine Exhibit Sketch of 1841 Wheel, and state when, where, and by whom it was made.

Ans. It was made by me in Mr. Mitchell's office, at New Britain, Ct. The date I am not able to give to the day of the month. I think it was some of the last days of July, if I am not mistaken, 1875.

Cross-int. 292. Can you give the day of the week?

Ans. It was on Tuesday, I believe.

Cross-int. 293. In what part of the day was it made?

Ans. About ten o'clock.

Cross-int. 294. Was any one present during the time, or any portion of the time, while you were making it? If so, who?

Ans. I don't remember as there was any one.

Cross-int. 295. Are all of the marks, lines, figures and letters which were made with pencil or pen, and now appear on this exhibit, made by you, and on that occasion, excepting what this examiner has just written?

Ans. All the pencil marks that's on here I made. The pen marks and a diagram of a bucket were made by Mr. Mitchell, I believe, by way of

explaining another form, by my direction; the other form of the bucket, I meant to be understood.

Cross-int. 296. Do you not know whether Mr. Mitchell made those marks, etc., that are made with a pen?

Ans. I do.

Cross-int. 297. When were they made?

Ans. Right away after I finished it; when he came in.

Cross-int. 298. What was the length, and what the diameter, of
83 the shaft of the wheel you made in 1841, of which you have testified?

Ans. The length was eight or ten feet; the size was eight or nine inches.

Cross-int. 299. Can you not tell its length within two feet, and its diameter within an inch?

Ans. I recollect distinctly the head of water, but I don't recollect the height of the sills of the mill above the water, and therefore I can't tell within two feet. I can't place it any other way. I couldn't fix the diameter any nigher than that.

Cross-int. 300. Was the size of the shaft the same throughout its full length; if not, wherein was there a variance?

Ans. I can't say whether it was or not; there was a gear on the top, but I don't recollect the size of it. I distinctly recollect putting it on.

Cross-int. 301. What was the width, and what the thickness of the rim of this wheel? State as accurately as you can.

Ans. The thickness two and a quarter inches, or two and a half; the width five inches.

Cross-int. 302. What was the width and what the thickness of the band of this wheel?

Ans. Quarter inch by three inches.

Cross-int. 303. What was the distance, meaning in a perpendicularly straight line, as the wheel stood when in operation, between the lower side of the rim and the upper edge of the band?

Ans. Eight inches.

Cross-int. 304. What was the distance, measuring on a radial line, between the inner edge of the rim and the shaft?

Ans. Between two and three inches—I can't define it more particularly.

Cross-int. 305. Can't you state whether it was nearer two than three inches?

Ans. It was between two and three inches. I couldn't set it any closer than that.

Cross-int. 306. What was the length of the buckets of this wheel, measuring in a straight line downward, from the lower side of the rim, and at right angles with the rim?

84 Ans. Near eleven inches.

Cross-int. 307. Suppose a straight edge placed across the inside of a bucket of that wheel, at its widest part; what would be the length or distance from the outer edge to the inner edge; I mean to have the straight edge placed horizontally across, that is, at right angles with a perpendicular line?

Ans. Seven inches, more or less, as a diagram might show.

Cross-int. 308. Suppose a straight edge placed as above, directly opposite the point where the bucket had been dug out the deepest; what would be the distance, as nearly as you can tell, between the inside of the straight edge and the deepest point in the bucket, measuring at right angles with the straight edge?

Ans. About an inch.

Cross-int. 309. Suppose another straight edge placed on the opposite side of the bucket—directly opposite, I mean, on the same horizontal plane, and parallel with the last named straight edge; what would be the distance, as nearly as you can state, from the inside of one straight edge to the inside of the other, measuring at right angles therewith?

Ans. Two and a half or three inches.

Cross-int. 310. Describe the size of the bolts by which the top ends of these buckets were fastened to the rim, and the way or manner of putting the bolts in.

Ans. They were half inch bolts—nuts let into the buckets below and the bolts screwed into them.

Cross-int. 311. How were the nuts confined in their places?

Ans. They were mortised the size of the nuts or a little larger, and the nuts put in; and when the bolts were in it, it held it there—it could not get off.

Cross-int. 312. How were the lower ends of the buckets fastened to the band?

Ans. Common screws—wood screws.

Cross-int. 313 Of what size were the screws, and how many were used with each bucket?

Ans. There were two screws to a bucket. I can't tell the exact size of them.

85 Cross-int. 314. Describe the screws as accurately as you can, as to length and thickness.

Ans. As near as I can describe them, they were an inch long and a quarter of an inch in diameter.

Cross-int. 315. How was the lower end of the shaft as to its position in relation to the lower edge of the band; or rather a horizontal plane at the lower edge of the band?

Ans. I think it reached a little below the lower end of the bucket.

Cross-int. 316. How much below, according to your best recollection?

Ans. Well, it might have been an inch.

Cross-int. 317. State, as accurately as you can, the position of the lower end of the bucket in relation to the lower edge of the band, or of a horizontal plane at the lower edge of the band.

Ans. I don't understand the question—in what relation he means.

Cross-int. 318. Suppose the lower edge of the band were to rest on a wide board, perfectly smooth and horizontal, and the wheel to be standing in an upright position in the same position as when operating; how far would it be in a straight, perpendicular line from the lower end of the bucket to the upper surface of that board, according to your best recollection?

Ans. The lower end of the bucket would rest on the board.

Cross-int. 319. Give, as accurately as you can, the dimensions of the stock out of which the buckets of that wheel were made.

Ans. From five to six inches wide, and from three to four inches thick as the diagram might call for.

Cross-int. 320. Can't you tell within an inch of the width, nor within an inch of the thickness of the blocks or plank out of which those buckets were made?

Ans. I made a pattern to make the buckets by, and I sawed the timber large enough for it; that's the best I can give.

Cross-int. 321. Question repeated.

Ans. I cannot, without making a drawing of it.

Cross-int. 322. What was the length of the blocks or the pieces

86 of plank out of which the buckets were made? I mean the length, measuring at right angles with the width.

Ans. Nearly eleven inches, or a little over.

Cross-int. 323. What was the thickness of the buckets of the wheel made by you in 1837, at the thickest part?

Ans. Somewhere from two to three inches.

Cross-int. 324. What part of the bucket was this, when the thickness was from two to three inches?

Ans. I can't define the position exactly.

Cross-int. 325. About what portion or part of the bucket was thus from two to three inches thick?

Ans. A little nearer the outside of the centre than the inside—about one third, perhaps. It tampered off a little slimmer on the inner end than the outer end, or rather edge. I can't define it any better, except I make a drawing of it.

Cross-int. 326. What was the thickness of the buckets of the wheel you made in 1841, in the thickest part?

Ans. From an inch and a half to two inches.

Cross-int. 327. How far was the thickest point of the bucket from the outer edge of the bucket, according to your best recollection?

Ans. Perhaps one third of the width of the rim, or more. I should have to make a drawing to define it.

Cross-int. 328. And about what portion of the bucket, as near as you can state, would have that thickness?

Ans. Two or three inches. The bucket is that thickness in one spot and diverges both ways. I can't tell what portion would be that thickness.

Cross-int. 329. Was the outer edge of the buckets of the wheel of 1841 a straight line from the lower side of the rim, downward, to the upper edge of the band?

Ans. They were.

Cross-int. 330. Were the inner edges of the buckets of that wheel straight lines, downward, from the lower side of the rim to a point opposite the upper edge of the band, on a horizontal plane?

Ans. They were not.

Cross-int. 331. How far downward from the lower side of the
87 rim towards such supposed horizontal plane were the inner edges straight lines, according to your best recollection?

Ans. About six inches.

Cross-int. 332. Did you give any instructions or directions or information as to the making of the model, Exhibit 3, that is, the block model, excepting what appears on Exhibit Sketch of 1841 Wheel?

Ans. I did not.

Cross-int. 333. Please examine Exhibit Sketch of 1841 Wheel, and state whether you are certain you made the cross near the torn, jagged end of the paper.

Ans. I did not make it.

Cross-int. 334. Did you make that sketch—I mean the sketch or drawing, Exhibit Sketch of 1841 Wheel, upon any scale; if so, what scale?

Ans. It appears that it is on a scale of three inches to the foot. It was made in a great hurry, and without tools to make it with.

Cross-int. 335. And this scale of three inches to the foot you have just now ascertained and determined by measurement, have you not?

Ans. I have.

Cross-int. 336. When you made that sketch or drawing, did you have

with you any other sketch, drawing, plan, minutes, or memoranda to aid you?

Ans. I had nothing whatever; it was from memory.

Cross-int. 337. Did you have at New Britain on that occasion Exhibit No. 7?

Ans. Yes, sir; I had that.

Cross-int. 338. Was the cross referred to in the three hundred and thirty-third cross-interrogatory made in your presence; if so, by whom?

Ans. I know nothing about it whatever.

Cross-int. 339. When and where did you first see the block model, Exhibit No. 3?

Ans. At Hartford, in the commissioner's room, the first day of the examination there; it was on Friday. I can't give you the day of the month.

88 Cross-int. 340. Did you see it before you commenced giving your testimony, taken by E. E. Marvin, esq., in this case?

Ans. It was about that time; it might have been a few minutes before; might have been an hour before; it was on that morning that I first saw it.

Cross-int. 341. The place where you first saw it was in the room where you gave your testimony, was it not?

Ans. It is possible that Mr. Mitchell came with it to the hotel. I can't say; it was that morning, at any rate, that I first saw it.

Cross-int. 342. Will you swear that you saw that model before you saw me in the room where you gave your testimony before said Marvin?

Ans. I will not.

Cross-int. 343. If you did see it, did you do anything with it before you commenced giving your testimony?

Ans. I have no recollection of ever doing anything with it, as I understand the question.

Cross-int. 344. Did you ever do anything with it prior to answering the questions propounded to you by Mr. Mitchell, and answered by you before Mr. Marvin, excepting taking it in your hand and looking it over?

Ans. I never did.

Cross-int. 345. Please give, as accurately as you can, the length and diameter or thickness of the shaft of the wheel made by you in 1850, and spoken of in your testimony before said Marvin.

Ans. Shaft might have been twelve feet long; diameter from eight to nine inches at the bottom and running straight perhaps three or four feet from the bottom, thence a rounding taper to the top, to the size of the gear put on to the top, perhaps seven inches in diameter.

Cross-int. 346. Give the width and thickness of its rim as accurately as you can.

Ans. Width five inches or nearly; the thickness somewhere near an inch and a half.

Cross-int. 347. Give the distance from the inside of the rim, on a radial line, to the shaft.

Ans. Between two and three inches.

89 Cross-int. 348. Can you not give this distance with greater accuracy?

Ans. I cannot.

Cross-int. 349. Why not?

Ans. I am not positive, perfectly, on the width of the rim to an eighth of an inch, perhaps a quarter; and within an inch on the shaft.

Cross-int. 350. Give the distance, as accurately as you can, between the lower side of the rim and the upper edge of the band, on a perpendicular line.

Ans. Eight inches or nearly.

Cross-int. 351. Give, as accurately as you can, the width and thickness of the band.

Ans. Nearly a quarter, or about a quarter, of an inch by three inches wide, or nearly three.

Cross-int. 352. How low down did the lower ends of the buckets come, as compared with the lower edge of the band, or as compared with a plane at the lower edge of the band?

Ans. About on the same plane or nearly that—intended to be.

Cross-int. 353. Where was the lower end of the shaft in relation to that plane—on it, above it, or below it? And if above or below it, how much?

Ans. Eight inches from the bottom of the rim, below it. An iron gudgeon reached from the end of the shaft a little lower than the buckets, there forming a step.

Cross-int. 354. Give the size of the blocks or pieces of plank out of which the buckets were made as accurately as you can. Please give the width, thickness, and length.

Ans. From five to six inches wide, three or four thick, as the drawing might show; length enough to make the twelve buckets—eleven inches long or thereabouts.

Cross-int. 355. How deep were they dug or scolloped out in the deepest place?

Ans. About an inch; perhaps an inch and a quarter.

Cross-int. 356. How thick were the buckets in the thickest place?

90 Ans. From an inch and a half to two inches.

Cross-int. 357. Was the outer edge, measuring from the lower side of the rim, downward, to the upper edge of the band, a straight line?

Ans. It was.

Cross-int. 358. Was the inner edge, measuring from the lower side of the rim, downward, a straight line for any distance? If so, for what distance, measuring downward from the lower side of the rim?

Ans. Six inches or about.

Cross-int. 359. It appears in your testimony that the upper ends of one-half of the buckets of this wheel were attached to the arms of the wheel. Please describe how and by what means they were so attached.

Ans. They were flattened off on the back, cut away, nearly through, and fastened by four common wood screws put through the arms into the buckets near the outer and inner ends.

Cross-int. 360. Was this the only fastening of the upper ends of those buckets?

Ans. They were screwed to the rims by large three-eighths of an inch lay screws.

Adjourned.

WORCESTER, MASS., *Aug.* 13, 1875.

Cross-int. 361 (by Mr. ABBOTT). On what scale was Exhibit 2 made?

Ans. I think it is an inch to a foot.

Cross-int. 362. Can you not state with certainty this scale?

Ans. I cannot; I did not make it.

Cross-int. 363. Can you tell the scale on which Exhibit 3 is made?

Ans. I think it is three inches to the foot.

(Counsel for respondent states that he has just discovered that the model maker in making Exhibit No. 3 from sketch of 1841
91 wheel, followed the scale—so far as the ink portion is concerned—indicated by the lines instead of the scale indicated by the figures, as he was instructed. That he has, therefore, ordered another model to be made, which will correctly represent the proportionate height of the floats above the band in both the 1841 wheel and the 1850 wheel; the height in the present model having been found on measurement to be a little too small.

The complainant's counsel cannot see the propriety of the above insertion, and, considering the testimony heretofore given by said Stowe, he regards it as an indirect and objectionable mode of making suggestions to the witness.

Counsel for respondent states that he disclaims any such intention, and purposely waited until witness had answered the last question.)

Cross-int. 364. Suppose a radial line, drawn from the centre of the shaft of each of the wheels made by you in 1837, in 1841 and 1850, and hereinbefore described, to the periphery or outer edge of the rim, and so as to just touch the inner edge of the bucket; then suppose you measure the distance between the radial line and the point of intersection or contact of the outer edge of the same bucket and the periphery or outer edge of the rim, measuring at right angles with said radial line; please give the distance from such point of contact to the radial line in each of said three wheels as accurately as you can.

Ans. To answer that question correctly there would have to be a drawing. My rule for establishing the plane of the bucket on leverage from the lowest place in the concave is forty five degrees to the radial line. Therefore, the plane would designate the distance, and that I cannot give without a drawing.

Cross-int. 365. Please state what you mean in the last answer by the phrase "the plane of the bucket on leverage;" and also by the word "plane," appearing afterwards in the same answer.

Ans. I did not use "leverage" at all. The word I used was "average."

Cross-int. 366. Please answer cross-int. 365, making the change of "leverage" to "average."

Ans. I don't make any straight lines on the bucket in that di-
92 rection. Therefore, in a curved line to conform to a straight line, I know no other way than to average it. The plane is a line from one radial line to the another at an idefinite distance on the circle, or from one circle to another, inside.

Cross-int. 367. Please refer again to cross-int. 364 and state as accurately as you can the distance between the radial line therein described and the point of intersection or contact therein stated, measuring on the periphery or outer edge of the rim, and give the distance on each of said wheels.

Ans. I can answer it no different from what I have. I cannot give the distance without a drawing. I don't like guessing.

Cross-int. 368. Please answer the last question as accurately as you can from your best recollection.

Ans. I have no means of recollecting anything about it, except by drawings. I couldn't tell that distance on a wheel I made three months ago.

Cross-int. 369. Do the answers you have given to cross-ints. 364 to 368, inclusive, apply to each and all of said three wheels?

Ans. So, or nearly so.

Cross-int. 370. Is there any exception; if so, what?

Ans. There might be a little variation in the angle.

Cross-int. 371. What variation, and in what wheels?

Ans. In the mode of progress in learning the action of the water upon a plane, I found an advantage in lengthening the plane. The plane of the '41 was longer than the plane of the '37, in proportion, that of '50 still a little longer.

Cross-int. 372. What plane, and how much longer in proportion?

Ans. The plane reaches from the lowest place of the concave, or the point farthest forward in the concave, to the inner edge of the bucket. I am unable to say how much longer in proportion. I know that I measured it, but how much I can't tell.

Cross-int. 373. And is that plane, I mean the plane described in your last answer above, the same plane; that is, do you mean the same thing by the word plane in your last answer as by the word plane in your answer to cross-int. 364?

93 Ans. I do.

Cross-int. 374. State the distance as accurately as you can from the "lowest place in the concave," named in answer to cross-int. 372, to the point of contact of the same bucket with the outer edge of the rim in each of said three wheels.

Ans. I don't understand in which direction you wish to get that distance.

Cross-int. 375. You may give the distance from that point, in a straight line, to the nearest point on the outer edge of the rim.

Ans. The '37 wheel, three or four inches; the '41 and '50, an inch and a-half or two inches.

Cross-int. 376. Can you answer the last question with more accuracy?

Ans. I cannot.

Cross-int. 377. Can you give, or have you any means of giving, any more accurate or definite answers to the questions commencing with the three hundred and sixty-fourth cross-interrogatory and ending with the last, than you have given?

Ans. Not except drawings.

Cross int. 378. What drawings do you refer to?

Ans. They don't exist. I would have to make them.

Cross-int. 379. Please now refer to Exhibit Sketch of 1837 Wheel, and state whether it is the same drawing referred to in your testimony before said Marvin, as having been made at Bristol when you were present.

(Counsel for respondent calls attention to the fact that this is the same sketch heretofore called for by counsel for complainant and referred to in remarks of the counsel respectively after cross-int. 291.)

Ans. It is not.

Cross-int. 380. Is this sketch now before you one of the two sketches about which you testified before said Marvin?

Ans. I think it is. I supposed it to be lost from what I understood at the time it was called for at Hartford. I didn't know it was here today.

Cross-int. 381. Was this sketch made at Bristol?

Ans. It was not.

94 Cross-int. 382. When and where was it made, and by whom, and in whose presence, if in the presence of any one?

Ans. I can't give you the day of the month. I think it was in May, some time in 1875, in Newark, New Jersey, in my house, by me. I don't recollect any one being present except my wife. Upon looking at the sketch I find it was the fourth of May.

Cross-int. 383. For what purpose and at whose request, if at the request of any one, was it made?

Ans. It was made for to answer—I can't think of the man's name, he was the agent of the National Water Wheel Company—his application to me for evidence to be used in an extension case of a patent; the names I can't give.

Cross-int. 384. Did you have this sketch with you at Bristol at the time spoken of in your testimony before said Marvin when Shepard and you think Ladd were present?

Ans. I did; and Mr. Shepard made a copy from it.

Cross-int. 385. On what scale is this sketch made?

Ans. An inch to the foot.

Cross-int. 386. When was the writing made at the bottom part or side of the sketch, and by whom?

Ans. Made immediately after the sketch; made by myself.

Cross-int. 387. Did the agent of the National Water Wheel Company remain at Newark till after you had made the sketch?

Ans. He did not remain there to my knowledge.

Cross-int. 388. How long did he remain there, so far as you know, and at what place did he stop?

Ans. He remained perhaps half an hour, in the shop where I was.

Cross-int. 389. Have you ever seen him since?

Ans. I think I have; know I have, at least.

Cross-int. 390. When and where?

Ans. At the depot at Bristol; he met me there and showed me the way to the office there.

Cross-int. 391. Was there any cover over either of the three wheels made by you in 1837, 1841 and 1850, and before spoken of?

95 Ans. There was nothing except the rim the buckets were fastened to.

Cross-int. 393. You regarded the Howd wheel, spoken of in your testimony, when you first saw it operate, as a good wheel, and the patent a valuable one, did you not?

Ans. I considered it a good wheel; I didn't know what the patent was about.

Cross-int. 394. Didn't you know it was a patented wheel?

Ans. Yes.

Cross-int. 395. When and where did you last see Mr. Napoleon B. Luce, and where does he now reside, so far as you know?

Ans. I saw him last in Hartland, Vt., in the month of August, 1860. I know nothing about where he resides now.

Cross-int. 396. When were you last in Halifax, Vt.?

Ans. It was in 1868 or '9, and I am not positive which.

Cross-int. 397. When last in Windsor, Vt.?

Ans. I was there the day before we met at Hartford. I can't tell you the date.

Cross-int. 398. Have you been acquainted with Henry Stowe, now or lately living at or near Green River, Vt.?

Ans. I don't recollect of knowing any such man as Henry Stowe. I have no recollection of any man of that name. It is possible that my cousin may have a son of that name; he, my cousin, lives at Halifax.

Cross-int. 399. Did you make the wheel that drove the saw in the Spear & Williams saw mill, before spoken of?

Ans. I did.

Cross-int. 400. Describe that wheel, generally.

Ans. There was a shaft perhaps fourteen feet long—it might not be as long as that—the wheel was eight feet; there were eight buckets, generally; they were cut in two in the center and set alternately. The wheel was about two feet in diameter and was what was called a fluted wheel.

Cross-int. 401. Did you make a water-wheel for Thomas Cobb? If so, when, of what kind, and for what purpose?

Ans. I did make one. It was in 1859. It was similar to the
96 Howd wheel; it was for driving a saw mill—sash and blind factory, doors, etc.

Cross-int. 402. Did you make a wheel for one Jenne? If so, when, where, of what kind, and for what purpose?

Ans. I made a wheel for Mr. Nathaniel Jenne. It was in 1849, I think, at Hartland, Vt.; fluted wheel of the same description as the other except the length of the shaft, which was not so long—the other fluted wheel I mean—for driving a saw mill. It might have been in 1850; I won't be certain.

Cross-int. 403. Did you make a wheel or wheels in St. Johnsbury—a water-wheel or water-wheels? If so, when, for whom, of what kind, and for what purpose?

Ans. I was in the employ of a man in St. Johnsbury and I made wheels. I made all the wheels for Mr. Luke Buzzell; I was in his employ. No. 1 was a five-foot wheel; it was the Howd wheel, improved; that was for Messrs. Ely & Wilder, hoe manufacturers, at St. Johnsbury, in 1857 or '8—eight, I think. I made a thirty-six inch wheel for a party close by—I can't recollect his name—for a carriage shop, on the same plan, in the same year; the third went to West Concord, Vt., to a bobbin shop; it was a forty-eight inch wheel of the same plan. The next was a five foot wheel that went to Barre, Vt., and drove a circular saw mill, etc.; of the same plan, the Howd improved. Also I built an overshot wheel to go to Kirby, Vt., the name of the party I don't recollect; it was for driving a saw mill. That, I believe, completes them, so far as I think now.

Cross-int. 404. Please now state all of the water-wheels which were made by you between the year 1837 and the time when you moved to Newark, N. J., excepting and excluding all that you have spoken of in your testimony, and excepting also such as may have been made when you were employed as in St. Johnsbury, and including only those where you had the direction as to their making, and give them in the order of time, as nearly as you can, and state, as accurately as you can, when, where, for whom, of what kind, and for what purpose, each such wheel was made.

Ans. After those that were made in 1837 and '41, I didn't make
97 any more wheels, I think, till I made them for Williams, in 1850. The next, I think, was made in Plattsbury, York State, on the Howd wheel plan, for a tannery, for a man by the name of Carter—I think his name was Carter; this was in 1853 or '54, as near as I can remember. The next was two wheels for myself, or rather for Stowe & Waterhouse, made in Plattsbury and moved to Wheelock, Vt.; one for a circular saw mill, and the other for a planing mill, turning, etc., sawing; they were the Howd wheel improved, and built in 1854 or '55—one for a man by the name of Sannders, Brownville, West Windsor, Vt., made at the same time Mr. Cobb's was made—Howd wheel improved—made at

Hartland, Vt. It was for driving a grist mill. That's the last before I moved to Newark.

Cross-int. 405. Which of those wheels, if any, were made or adopted by your recommendation?

Ans. They were all made by my recommendation, secondly.

Cross-int. 406. Where did you get the paper which the drawings or sketches for making Exhibit 5 and 6 were made?

Ans. I don't know.

Cross-int. 407. Is Exhibit No. 1 a working wheel and made for that purpose?

Ans. It is a working wheel made for that purpose or to show him—both.

Cross-int. 408. Was there ever any testing, to your knowledge, of either of the wheels made by you at Newark, N. J., or of either of the three wheels made by you in 1837, 1841, and 1850, and already described?

Ans. Not that I know of, except in comparing their work with other water-wheels; no scientific test.

Cross-int. 409. Did you ever obtain or apply for a patent on water-wheels? If so, when?

Ans. I find a caveat on wheels in 1872, I think it was. I never obtained a patent in my own name, or applied for one. I filed a caveat. I can tell the story if necessary.

98 Cross-int. 410. Please examine that part of the sketch of 1837, wheel included within the four small letters *a* just placed thereon by the examiner, and state what it represents.

Ans. It represents a block carved for the purpose of holding the water to the wheel, about one-third of the way round it—may not be as much.

Cross-int. 411. Was it not one-sixth instead of one-third?

Ans. I think it is one-sixth.

Cross-int. 412. What is represented by the part enclosed by four small letters *b*, just placed thereon by the examiner?

Ans. It's a block on the inner side of the spout, with a concave cut in for the gate to swing into.

Cross-int. 413. Which end of the spout?

Ans. Next to the wheel, as close as it can be.

Cross-int. 414. What is represented by the part enclosed by the four small letters *c*, just placed thereon by the examiner?

Ans. The outer side of the spout, next to the wheel.

Cross-int. 415. And does it also represent at what point, or in what way, it was connected with the wheel?

Ans. It represents it in right angles, I think, at the point where it strikes the block on the radius line, or nearly so.

Cross-int. 416. Did the gate swing on a pivot? If so, did the pivot extend through the spout? And point it out on the sketch where it is represented, and state its size, as near as you can.

Ans. It did. The top extended through the spout, and the bottom did not; the point where it is indicated by the letter *d*. It was somewhat near three inches in diameter.

Cross-int. 417. Did the pivot extend through the open part of the spout?

Ans. It did not.

Cross-int. 418. How far did it extend into the spout?

Ans. It didn't extend into the spout any.

Cross int. 419. How far apart were the buckets in each of the three

wheels made by you in 1837, 1841, and 1850, before spoken of? Please state as accurately as you can.

Ans. One-twelfth of the circumference of the wheel.

Cross-int. 420. I think my question is not understood as in-
99 tended. I wish to know the distance or width of the open space between any two buckets in each of those three wheels, between points where they come nearest together.

Ans. Nearly eight inches on the seven-foot wheel—the 1873 wheel—about eight inches; it may be more or less. The next, I should have to have a sketch; I could not get at that distance accurately; and the 1850 Wheel likewise—the 1849 and 1850—they were nearly three inches; about three, more or less.

Cross-int. 421. The last part of the last answer you was aided in making, were you not, by examining and measuring the Exhibit Sketch of 1841 wheel, and the first part by examining and measuring the Exhibit Sketch of 1837 Wheel?

Ans. I was.

Cross-int. 422. How much was the bottom of each bucket in each of those three wheels brought forward or upward from a vertical to a horizontal line? State as accurately as you can, and using the same sketches to aid you.

Ans. The lower part of the bucket falls back about three inches to the radius line of the inner edge of the bucket, from the outer edge of the bucket. They are nearly alike, on account of making the plane longer in proportion on the 1841 wheel than I did on the 1837 wheel; there is very little difference.

Cross-int. 423. Could you have answered these questions (commencing with cross-int. 420) without reference to these sketches?

Ans. Not so well, I could not.

Cross-int. 424. How many buckets in each of the wheels you have made at Newark?

Ans. The first wheels I made at Newark were eight buckets, in 1861, or 1862. The wheels referred to, made on this plan, the bottom part of the buckets—I don't know what you call them—are all made with twelve buckets.

Cross-int. 425. To what wheels do you refer in your last answer, as having been made in 1861 and 1862? State generally what kind of wheels, and for what purpose.

Ans. They were made on the Howd wheel improved plan; one for a bending establishment, two for a gristmill, and a fourth for a bolt
100 establishment—carriage bolts. They were made along from 1860 to 1865. I could not give the dates, but somewhere in that time.

Cross-int. 426. Referring to the wheels you made at Newark, and spoken of in your testimony before said Marvin, and state whether their buckets lapped over or by each other; and, if so, how much?

Ans. The radial line of the inner edge of one bucket passed the radial line of the next bucket on the back nearly a quarter of an inch, more or less; that's on the first wheels I made on that plan there. I afterwards let more water onto the wheel; consequently I had to cut off the inner edge of each bucket to give a discharge room equal to the inlet, which brings the radial line of the inner edge of each bucket nearly to the radial line of the back of each bucket.

Cross-int. 427. In the extension case referred to in your three hundred and eighty-third answer did you testify?

Ans. I did.

Cross-int. 428. And did you produce on that occasion and leave with the examiner Exhibit Sketch of 1837 Wheel?

Ans. I did. I left it there; I don't know who with.

Cross-int. 429. I now extract certain portions of the testimony which I understand you then gave: "Int. 27. State in general for whom the wheel was made, of what material, of what size, how long it worked, and if it differed at all from the wheels before described, in what respects. Ans. It was made for Joshua Spear, of Hartland, Vt.; of wood, except the iron band around the bottom of the buckets; of twenty-four inches in size, in diameter. I do not know certainly how long it worked, but for ten or fifteen years. It did not differ in any respect from the wheels before described." Were you inquired of and did you answer as above?

Ans. I did; my answer was given as regards the extension case. The wheel didn't deviate from the principles by which I was questioned upon.

Cross-int. 430. I make another extract: "Cross-int. 31. The wheel described by you as now made by you has buckets of different shape from that shown in in Exhibit C, does it not? Ans. Yes, sir." Did you testify as above?

101 Ans. I did.

Cross-int. 431. And Exhibit C is this Exhibit Sketch of 1837 Wheel, is it not?

Ans. Yes, sir.

Cross-int. 432. I quote again: "Cross-int. 36. I notice that you said in your seventh answer that the sketch Exhibit C corresponded to the portions of the wheel made for David Fisher, represented therein, as near as you could recollect. Why did you qualify your answer by saying it was as near as you could recollect? Ans. I know not except that the qualification was made to have it as near right as I can. It is a good many years." Did you so testify?

Ans. I did.

Cross-int. 433. I again make an extract: "Cross-int. 40. What was the distance of the rim from the shaft in each wheel? Ans. In the large wheel the top rim was about a foot wide. I can't remember the size of the shaft; think it was about fourteen inches. The distance from the inner edge of the rim to the shaft was about twenty-three inches. In the second wheel, as near as I can recollect, the top rim was about six inches wide, and the shaft might have been ten inches in diameter." Did you so testify?

Ans. I suppose I did; I am not inclined to dispute it.

Cross-int. 434. Again: "Cross-int. 43. What was the distance between the nearest adjacent parts of each two buckets in the three first wheels you have mentioned? Ans. The buckets were calculated to be somewhere near three inches thick in the large wheel, and somewhere about half that in the small wheel in the centre. They ran off thinner on the edge." Did you so testify?

Ans. Yes.

Cross-int. 435. Once more: "Cross-int. 44. What distance did each bucket in the large wheel occupy on the circumference of the wheel that is to say, how far was it from the greatest convexity to a perpendicular line drawn up from the extreme edge of the part which was inclined to the rear? Ans. I should think about nine inches. I cannot recollect distinctly such small points." Did you so testify?

102 Ans. I think I did.

Cross int. 436. Again: "Cross-int. 48. Was the lower or inclined

part of the bucket also concave? Ans. Yes, sir; to conform with the other." Did you so testify?

Ans. I did.

Cross-int. 437. Once more: "R. cross-int. 53. And how much space is there vertically between the buckets where they lap over? Ans. On a twenty-four inch wheel, an inch and a half; they vary a little in different sized wheels; in thirty-six inch wheels it is two and a quarter inches." Did you so testify?

(Objected to by respondent's counsel as not pertinent to a cross-examination, the wheels referred to not being the wheels under consideration.)

Ans. I did.

Cross-int. 438. Do you consider or regard any of the wheels made by you at Newark, and testified about by you before said Marvin, as being substantially like the wheels manufactured by the said National Wheel Company of Bristol?

(Objected to by respondent's counsel, first, because it is a question proper to be put to an expert only; and second, because it does not particularize what wheels among those testified to before Marvin are referred to.)

Ans. In principle they are alike in some respects; in detail they are not, in some.

Cross-int. 439. How many times have you come from Newark since last May into this or any other New England State for the purpose of testifying or giving information in behalf of the defence in this suit?

Ans. I think it is three times.

Cross-int. 440. You came voluntarily and without a summons each time, did you not?

Ans. I did.

Cross-int. 441. And you voluntarily furnished sketch or sketches for models, did you not?

Ans. I did.

Cross-int. 442. You are informed or understand, do you not,
103 that this suit is defended by said National Wheel Company, of Bristol?

Ans. I do.

Cross-int. 443. And you have assisted said Ladd, acting in behalf of said company, in finding witnesses for the defence, have you not?

Ans. I went with him, I being acquainted with them.

Cross-int. 444. To what place?

Ans. No other place except Hartland, Vt.

Cross-int. 445. Do you not understand, apprehend or suppose, in case the validity of the patent involved in this case should be established, that you may be held liable as an infringer of it?

Ans. I suppose it to be the case. I have never seen the drawings, specifications or anything connected with the Swain wheel to know whether it is so or not.

Redirect by Mr. MITCHELL:

Int. 446. I notice upon Exhibit Sketch of 1837 Wheel a reference to these wheels we have had under consideration as being "like this." To what does the words "like this" refer?

Ans. In principle of the centre and downward discharge combined?

Int. 447. Do the words quoted, "like this," mean that all the gates are of the character shown here? Please explain.

Ans. The 1837 and '41 gates were like that, but the 1850 was not.

Int. 448. Wherein does the 1850 gate differ therefrom, and why?

Ans. It hoisted in the flume in the lieu of at the mouth of the spout, because those of 1837 and '41 wore and leaked; being made of wood, I couldn't keep it tight—couldn't make it a success.

Int. 449. You have stated in your cross-examination that the Exhibit Sketch of 1837 Wheel is the one you gave to James Shepard in
104 May last at Bristol, referred to first in answer to cross-int. 209, and yet in answer to cross-int. 210 you appear to say that the same sketch is made by Mr. Shepard in your presence; please explain this apparent discrepancy if you can.

Ans. I can't explain it in any other way than that I didn't under stand the question.

Int. 450. What sketch, if any, was made by Mr. Shepard in your presence, and referred to in answer to cross-int. 210?

Ans. He made a copy of this on white paper in ink—I mean a copy of Exhibit Sketch of 1837 Wheel.

Int. 451. Do you know why a copy was made by the model-maker, instead of using the original sketch; and, if so, will you give the reason?

Ans. All I know is, that some one said it didn't look well enough to send to the Patent-Office. That's all I know about it.

Int. 452. Was it to Plattsburg or to Cornish that you went in June, 1850?

Ans. To Cornish.

Int. 453. Please hear read the answers to cross-ints. 87 and 92, and explain the same if you can.

Ans. When I made the drawing—after I got the drawing done, I packed up my tools. I put that in with all other such things I have a place for in the chest. I left them to go to Cornish, N. H., in June, 1850. Then I left the same place, after returning in June, 1852, to go to Plattsburg, N. Y.; and some way in that was the way the mistake was made.

Int. 454. Do you mean by the same place, in your last answer, Hartland or Grafton?

Ans. At Hartland.

[Adjourned.]

AUGUST 17, 1875.

Int. 455. Please hear read cross-int. 238, to which you answered "twelve inches," and state what you understood to be the meaning of the question.

Ans. I understood from the crown or under side of the rim of the wheel to the band.

105 Int. 456. Suppose you had understood the question to ask the distance in a perpendicular line to the lowest point in the bucket from the extreme top thereof, what would your answer have been?

Ans. Seventeen inches, or about that.

Int. 457. Do you mean by your answer to cross-int. 335 that you first discovered at the time when said question was asked, that Exhibit Sketch of 1841 Wheel was drawn on the scale of three inches to the foot? Or please explain your meaning.

A. Well, when I made the sketch I intended it three inches to the foot.

Int. 458. In your answer to cross-int. 405, you state that certain Howd wheels were made by your recommendation; secondly, please explain your meaning more fully.

Ans. I always recommended the other—the downward and central

discharge—that would be first. People that would be acquainted with the Howd wheel did not choose to try any experiments.

(Answer objected to as irresponsive and inadmissible in redirect.)

Int. 459. Does the same reason apply to the fact that you first made Howd wheels when you went to New Jersey? Please give the reason, whatever it may have been.

Ans. The same reason.

Int. 460. In your answer to cross-int. 256, you speak of the length of the timber from which you made the buckets of the 1837 wheel as somewhere in the neighborhood of twelve feet, as you think. Do you mean that that was the average length of the sticks used; or do you mean that you obtained all the buckets from a single stick; or if neither, what was your meaning?

(Question objected to as suggesting the desired answer.)

Ans. I mean that there were sticks enough to make the buckets required, more or less.

Int. 461. In your answer to cross-int. 236, you use the phrase "the inner edge of the rim was five feet, nearly"; please hear the question and answer read, and explain a little more explicitly what you wish to be understood thereby.

Ans. I mean to be understood that I can't recollect into an eighth of an inch the width of that rim—that's nearly.

106 Int. 462. Please express the same idea in different words; what was it that was "five feet nearly" in that rim?

Ans. The distance between the two inner edges. I might say the opsite inner edges.

Int. 463. Referring now to your testimony in the extension case, were you asked as follows: "Referring to cross-int. 41, wherein do the buckets of the wheels now made by you differ from the buckets shown in Exhibit C?" And state whether or not you answered thereto, "They run back farther from the radial line on the inner edge and bottom; they differed in no other respect. The last four of the seven wheels I have made were all iron and made after this pattern; and one more I have since thought of."

(Question objected to as not explanatory of anything elicited in cross-examination, not connected therewith, and inadmissible in redirect.

Counsel for respondent refers to cross-int. 430 for the matter drawn out in cross-examination to which the matter referred to in this question is explanatory.)

Ans. I suppose so; I can't dispute it.

Int. 464. What is your best recollection?

Ans. I recollect something about the last wheel that I thought of; I don't recollect anything about the rest of the question now.

Int. 465. State whether or not in your testimony in the extension case you were asked "if you were certain the sketch (referring to Exhibit C) does correctly represent the wheel as far as it goes?" and whether you answered, "In the principle and design it does." I refer to cross-int. 37 and its answer.

(Objected to by Mr. Abbott as inadmissible, both as to form and substance.

Counsel for respondent refers to cross-int. 432.)

Ans. I don't remember having the question asked me.

Int. 466. Question repeated, and witness requested to refresh his recollection by reading from a printed copy of his testimony which is handed him.

(Objection repeated, and complainant's counsel also objects to the

proceeding touching the refreshing the witness's recollection be-
107 cause he, complainant's counsel, had not been permitted to see the alleged printed copy, and because there is no evidence that it is a copy of the testimony given by the present witness in the extension case.)

Ans. These questions, then and now, are confounded with me, and I can't tell whether they were asked last week or last May; I can't decide now.

Int. 467. State whether you were, on said examination, further asked as follows: "Cross-int. 38. In what parts or respects are you uncertain about?" And did you answer, "Perhaps I have not got the height quite right."

(Objected to for same reasons as the last.)

Ans. I cannot swear to the identical questions being asked at any certain time.

Int. 468. Do you find the questions and answers referred to in the last three questions in the printed copy before you, which purports to be your testimony taken last May in the extension case?

(Objected to as above, and because inadmissible.)

Ans. I find them here.

Int. 469. Have you any reason to doubt their correctness?

(Objected to, both as to form and substance.)

Ans. I have not.

(Counsel for respondent states that the printed copy handed the witness is one of several printed copies, made for the use of the Patent Office, of the testimony referred to in the cross-examination, as taken at Bristol in May last; and states also that the only reason why he declined to furnish the same to the opposing counsel was because he has only one copy thereof present, and opposing counsel also have a copy, which they have made use of in cross-examination.

To which complainant's counsel states that he has never read, or been permitted to read, any one of the alleged printed copies, or any part thereof, although a copy was requested of respondent's counsel at the taking of testimony at Hartford, before referred to, and refused by respondent's counsel, when he admitted that he had more than one copy. And another reason why he has objected to this copy being exhibited to the witness is because, as he is informed, it contains sundry writings, in pen or pencil, not part of the testimony.

108 Counsel for respondent states that he had only one copy at Hartford on the occasion referred to, and that he made no admissions to the contrary. He states further that the other side then had a written copy which they made use of there and then as well as before the present examiner; and counsel says that if any of the questions and answers quoted to the present witness are incorrect, he would be glad to have them corrected from the written copy which the complainant's counsel possess.

After the above statement the complainant's counsel deems it proper to add, that while respondent's counsel at Hartford stated that he had with him but one printed copy, he also stated that he had others at his office in New Britain, whither he went nights while the testimony was being given, and would bring a copy for the examination of complainant's counsel if he should think proper; and that on his return from New Britain he informed complainant's counsel that he did not think to bring it, but it was just as well, for he had decided not to let him have it.

Counsel for respondent admits that he forgot to bring a copy to com-

plainant's counsel, as stated; and that he had added (jestingly, in view of the fact that the complainant's counsel had a copy) that it would have made no difference if he had remembered it. He denies that he went to New Britain more than once after the request.)

Int. 470. You state in your answer to cross-int. 353 that the shaft of the 1850 wheel extended from the bottom of the rim, eight inches below it. Please look at the model now handed to the examiner to be marked and state whether or not, in the respect referred to in said cross question, the model correctly represents said wheel.

(The model referred to in the last question is marked Exhibit No. 7, J. Henry Hill, examiner.)

(Question objected to as improper in re-direct; and complainant's counsel also objects to the introduction of Exhibit No. 7, as inadmissible at this stage of the examination.)

Ans. It does.

Int. 471. Examine said model carefully, and if it differs in any
109 respect from the 1850 wheel made by you and placed in the Spear & Williams mill, as testified by you, please point out the difference. I do not refer, however, in this question to differences of material.

(Question objected to as improper in redirect and inadmissible, and the objection, as well as all others taken by complainant's counsel before this examiner, will be insisted on at the hearing.)

Ans. It is a true copy in principle generally.

(Answer objected to as competent only by approved experts.)

Int. 472. Do you find any difference in the construction, excepting the differences of material and bolts, screws, etc., pointed out by you in your previous testimony?

(Question objected to for same reasons as for four hundred seventy-one.)

Ans. I don't perceive any.

Cross-examination resumed by Mr. ABBOTT:

Cross-int. 473 (de bene). Please refer to your answer to four hundred and fifty-eighth redirect, and give the names of the persons to whom you recommended the downward and central discharge, and who declined, or who did not choose to try that kind of wheel, and state when and where, and in whose presence such recommendation and such declining occurred. Also state where each person, who may be named in your answer, now lives, according to your best knowledge and information.

Ans. Mr. Carter, of Plattsburg, N. Y.; Thomas Cobb, of Hartland, Vt.; Dr. Sanders, Brownsville, West Windsor, Vt. I think Mr. Cobb was present at the time of the conversation with Dr. Sanders. The next is Timothy Gladson, of Montville, N. J.; the next is Mr. Farmer, of Newark, N. J.; that is all I recollect. I can't give the date of Mr. Carter within two or three years; somewhere 1853 or '4; no one present that I recollect of; it was at Plattsburg, where he now lives, so far as I know. Don't remember any one being present when I had the conversation with Mr. Cobb first; it was at Hartland, Vt., in 1859; I think he is not living. Mr. Cobb and I put in Dr. Sanders's wheel together. When Dr. Sanders came to contract for the wheel Mr. Cobb was present; he advised Dr. Sanders not to use that part—this being after Mr.
Cobb's wheel was in and running; this was in 1850; Dr. Sanders
110 lived in Brownville, the last I knew. I don't recollect of any one being present at the conversation with Timothy Gladson; it

was in 1862 or '3, at Newark, N. J.; Mr. Gladson lives at Montville, N. J. I don't recollect of any one being present with Mr. Farmer; it was in Newark, N. J., in 1864 or '5; he lived at Newark the last I knew of him.

Cross-int. 474. Please give the Christian name of the Mr. Carter referred to in your last answer.

Ans. I don't know that I ever knew his Christian name.

Cross-int. 475. In what part of Plattsburg did he reside, and in what business was he engaged when you last knew him, and when did you last see him?

Ans. I don't know in what part he resided. He was in the tanning business. I last saw him somewhere along 1854 or '55; I can't exactly tell.

Cross-int. 476 (de bene). When did you first see the model Exhibit No. 7.

Ans. This forenoon.

Cross-int. 477 (de bene). By whom was it made?

Ans. I don't know.

Cross-int. 478 (de bene). Was it made under, or in accordance with, your direction?

Ans. It appears to be made from the sketch which I made in Mr. Mitchell's office; so far it was made under my direction.

Cross-int. 479 (de bene). Did you give any other direction than what appears on that sketch in relation to the making of Exhibit No. 7?

Ans. I gave Mr. Mitchell directions in relation to making the length of shaft for the distance that goes below the rim.

Cross-int. 480 (de bene). Did you give any other directions, sketch, drawing, plan, figures, or dimensions in relation to said Exhibit No. 7?

Ans. None except the sketch that I mentioned.

Cross-int. 481 (de bene). And the sketch that you mentioned is the sketch you made in Mr. Mitchell's office, and heretofore produced before this examiner, and marked "Exhibit Sketch of 1841 Wheel," is it not?

111 Ans. That's the sketch I made in Mr. Mitchell's office.

Cross-int. 482 (de bene). Question repeated.

Ans. This sketch was intended for the wheel of 1850; a part of it I see. It is a mistake of Mr. Mitchell's being made; that is all.

Cross-int. 483 (de bene). Please refer to your four hundred and eightieth answer, and then answer my question, which is, whether the sketch referred to in that answer is the sketch marked Exhibit Sketch of 1841 Wheel.

Ans. It is the sketch I made then.

Cross-int. 484 (de bene). Question repeated.

Ans. It is that identical sketch.

Cross-int. 485 (de bene). Please refer to your four hundred and seventy-ninth answer, and then state as accurately as you can just what directions you gave Mr. Mitchell "in relation to making the length of shaft for the distance that goes below the rim." Give your language as accurately as you can.

Ans. I told him to make it eight inches from the lower side of the rim to the lower end of the shaft; six inches for the arms, two inches for a band.

Cross-int. 486 (de bene). And does this answer include all of the directions which you gave said Mitchell touching the making of Exhibit No. 7, excepting the sketch referred to?

Ans. All that I recollect of.

Cross-int. 487 (de bene). When, where, and in whose presence did you give the directions referred to in your last but one answer and in your four hundred and seventy-ninth answer?

Ans. I think it was last Thursday. I think it was in the Waldo House, Worcester. I don't know who was present; they were all strangers to me.

Cross-int. 488 (de bene). What time on Thursday, as accurately as you can state?

Ans. I shall have to correct the place—come to think I am mistaken by your asking me the time. It was before the ticket-office at the Boston and Worcester depot, Worcester. I recollect Mr. Mitchell came in when I was buying my ticket for Ashland, about a quarter before six.

Cross-int. 489 (de bene). Where did you first see Exhibit No. 7?

Ans. In this office.

112 Cross-int. 490 (de bene). Have you measured it or any part of it?

Ans. I have not.

(Mr. Mitchell states that he also derived the height of the arms, to wit, six inches, or, when reduced to the scale of the model, an inch and a half, from Mr. Stowe's answer to int. 30 when speaking of the 1841 wheel; the fact that the arms were below the crown, from Mr. Stowe's answer to int. 40 (referring to the 1850 wheel), and the fact that the thickness of each arm was equal to one inch, or, when reduced to the scale of the model, one-fourth of an inch, from Mr. Stowe's answer to int. 42, and the fact that the shaft extended eight inches below the rim, or, when reduced to the scale of the model, two inches, from Mr. Stowe's answer to cross-int. 353.

Complainant's counsel can see no propriety of encumbering the record with the preceding remarks of the respondent's counsel, and claims that they should not be regarded as having any bearing upon the case, and especially upon the testimony to-day given by said Stowe.)

JOHN L. STOWE.

Attest:

J. HENRY HILL,
Examiner.

Deposition of Sumner B. Small.

HARTFORD, CONN., *Aug.* 2, 1875—8 a. m.

Direct examination by C. E. MITCHELL, Esq., of counsel for defendant:

Int. 1. State your name, age, residence, and occupation.

Ans. My name is Sumner B. Small; my age is sixty-three; my residence is Hartland, Vt., and my occupation is carpenter and joiner.

Int. 2. How long have you worked at that trade?

Ans. I commenced at it in 1829, and have worked at it more or less ever since.

Int. 3. What proportion of the time have you worked at that trade?

Ans. Seven months in the year, every year.

113 Int. 4. Are you acquainted with John L. Stowe, of Newark, N. J., and, if so, how long have you known him, and where did you become acquainted with him?

Ans. I do know him. I become acquainted with in 1849 at Hartland, Vt.

Int. 5. Under what circumstances did you first become acquainted with Mr. Stowe?

Ans. Framing a saw-mill.

Int. 6. What saw-mill?

Ans. It was called the Spear Mill—Spear & Williams' Mill.

Int. 7. How long did you work upon this mill, and who worked with you?

Ans. I could not tell the exact time that I did work; commenced about the 1st of November; am sure I worked that month. I had another spell of working there, I think, in March, the next spring. I had two or three spells of working there a day or two at a time; could not tell when without my book. I worked with John L. Stowe.

Int. 8. When was the mill finished so that it commenced running?

Ans. I think it was in March, 1850.

Int. 9. At how early a date are you able to swear positively that the Spear Mill, on which you and Stowe worked, as you have stated, commenced running?

Ans. I could not fix the date. I know it was running before the snow got off the ground in the spring of 1850, because they got in logs to the mill on sleds.

Int. 10. At what work were you last employed with Stowe before the mill was in running order?

Ans. I think the last I was at work with him was in putting in the gig-wheel. I helped him a day, or about a day, at that.

Int. 11. How long were you employed in putting in the wheel?

Ans. Not over one day.

Int. 12. Do you know who made the wheel that you and Stowe put in?

Ans. John L. Stowe.

Int. 13. Where was it made, if you know?

114 Ans. The wheel was made in the Spear shop.

Int. 14. Did you see Mr. Stowe make it?

Ans. I was in the shop a number of times during the time he was making it, and saw him to work on it.

Int. 15. What was the size of the wheel, and in what direction did it turn; that is, whether vertically or horizontally?

Ans. I never measured the wheel, but he called it a two feet wheel, and I should say it was that. It turned horizontally.

Int. 16. Of what materials was it made?

Ans. Of wood mostly. There was an iron band around the bottom of the wheel that formed the iron part; there was an iron at the end of the shaft; an iron gudgeon I should call it; that was all the iron work.

Int. 17. Please describe the wheel commencing at the shaft, describing each part outward and downward.

Ans. The shaft was some eight or ten feet long and eight or ten inches through; towards the bottom of this shaft there was arms framed through, and on those arms there was a bucket; on the lower end of the bucket there was a band of iron put round, and over the arms there was a circle of plank.

Int. 18. What was the number of buckets in comparison with the number of spokes?

Ans. Just double, I think.

Int. 19. What was the width of the circle of plank, and what was its position relatively to the buckets?

Ans. I never measured the width of the plank. I should call it eight or nine inches. It was directly over the buckets.

Int. 20. From what direction did the water enter the wheel, outside or inside?

Ans. Outside.

Int. 21. What was the shape of the buckets?

Ans. Well, I should call them shoe shape.

Int. 22. What do you mean by a "shoe shape"?

Ans. Hollowed out and turned forward.

Int. 23. What parts of the buckets were turned forward?

Ans. The lower part. I should think a quarter of the length of it.

115 Int. 24. Do you mean by "forward" the direction in which the wheel was going, or the opposite direction?

Ans. I call it the opposite.

Int. 25. Which was the farthest "forward," using that word in the same sense you used it before, the outer edge of the bucket just under the crown, or the inner edge of bucket under the crown?

Ans. I could not tell you which was the farthest forward.

Int. 26. Look at the block model, defendant's Exhibit No. 3, and point out all the differences between it and the wheel you have described.

Ans. It was like that. With the exception of the circle being above the arms, instead of below, as here, it was identical.

Int. 27. Examine the buckets carefully of the model, Exhibit 3, and state if you are sure that they are identical in shape with the buckets of the wheel put in by you and Stowe?

Ans. I can see no deviation in the shape of them.

Int. 28. Are they the same in shape?

Ans. Yes, sir.

Int. 29. For the purpose of ascertaining whether you understood int. 25, I will ask which part of the bucket extended farthest "forward," the bottom edge, the inner edge, or whether they were the same?

Ans. The bottom inner edge.

Int. 30. How long was this wheel in operation, to your knowledge?

Ans. Ten years.

Int. 31. Do you know whether the wheel worked successfully?

Ans. It did.

Int. 32. For what purpose was it used?

Ans. Running back the carriage to the saw-mill.

Int. 33. In what directions did the water discharge; that is, leave the buckets?

Ans. In and downwards.

Cross-examined by Mr. ABBOTT:

Cross int. 34. Will you give the names of any other persons who worked upon the construction of that saw mill?

116 Ans. No one but Stowe and I, during my working there.

Cross-int. 35. What was you doing in November, 1849, as to that saw-mill?

Ans. Framing the mill.

Cross-int. 36. And what was said Stowe doing at the same time?

Ans. Setting out the frame and helping frame.

Cross-int. 37. Who made the wheel that drove that saw-mill?

Ans. Stowe.

Cross-int. 38. The same Mr. Stowe above referred to?

Ans. Yes, sir.

Cross-int. 39. Did you see him make it?

Ans. Occasionally.

Cross-int. 40. Describe that wheel as accurately as you can.

Ans. The wheel shaft was about eight feet long; how large the wheel was I am not able to say; and the wheel itself and the floats were about eight feet long.

Cross-int. 41. Can you give no further description of that wheel?

Ans. I cannot.

Cross-int. 42. When was that wheel made? Give the time as accurately as you can.

Ans. It was made between November, 1849, and the next March.

Cross-int. 43. Who placed or put that wheel in position to run?

Ans. I do not know.

Cross-int. 44. In what way or direction did it revolve? And describe the manner in which the water was passed to or upon the wheel.

Ans. It revolved up stream, or one part of it did and one part of it down stream. The water was passed to the wheel on a shute from the flume to the lower edge of the wheel.

Cross-int. 45. Describe the shute as accurately as you can.

Ans. I could not tell on what angle the shute lay. It lay on a slant for the water to pass over the shute and under the wheel; at what angle I could not tell.

Cross int. 46. Give the length and size of the shute as accurately as you can.

Ans. The width was the same as the wheel—eight feet. The
117 length was between two and three feet, I think; I never measured it.

Cross-int. 47. Can you state with accuracy and certainty any of the times when you worked on that saw-mill?

Ans. I could not accurately the number of the times.

Cross-int. 48. Question repeated.

Ans. I cannot without my book.

Cross-int. 49. Where is your book?

Ans. Hartland.

Cross-int. 50. Why did you not bring it?

Ans. I did not know I should want it.

Cross-int. 51. Did not you know before you left home that you was to be questioned as to the times when you worked on that saw-mill?

Ans. I did not.

Cross-int. 52. Who requested you to come to this place to testify in this case?

Ans. Mr. Ladd.

Cross-int. 53. When?

Ans. Last Thursday morning.

Cross-int. 54. Was the said Mr. Stowe with him at the time?

Ans. He was.

Cross-int. 55. Did not Mr. Stowe also ask you to come?

Ans. He did not.

Cross-int. 56. You all three came together from Hartland to this place, did you not?

Ans. Yes; on the same train.

Cross int. 57. And was not the testimony you was to give talked over, either at Hartland or on the way here?

Ans. I do not know that it was. I have no knowledge of its being talked of whatever.

Cross-int. 58. Do you mean to be understood that nothing was said by or between you and said Ladd, or you and said Stowe, or between said

Ladd and said Stowe, in your hearing, about your testimony, at Hartland or on your way thence to this place?

Ans. I cannot remember that there was any conversation took place in regard to testimony at all.

118 Cross-int. 59. What did you suppose you was coming down here for?

Ans. I did not know what I was coming for.

Cross-int. 60. Your book could show the times when you worked on that saw-mill, would it not?

Ans. It would, sir.

Cross-int. 61. Have you recently given your testimony touching the same matters about which this deposition is being now taken?

Ans. I have, sir.

Cross-int. 62. When and where, and before whom?

Ans. In May last, at Bristol, Conn. I do not know the name of the magistrate.

Cross-int. 63. Did the same Mr. Mitchell question you on that occasion who has questioned you to-day?

Ans. He did.

Cross-int. 64. You went from said Hartland to Bristol for that purpose, did you not?

Ans. I did.

Cross-int. 65. With whom, and at whose request?

Ans. Mr. Ladd, and at his request.

Cross-int. 66. Was not Mr. Stowe with you also?

Ans. He was on the same train; we were not together all the while.

Cross-int. 67. Were you and Mr. Ladd together all the while?

Ans. We were not.

Cross-int. 68. Did not said Stowe and Mr. Ladd come to you together, and at the same time, at Hartland, on that occasion?

Ans. They did, sir.

Cross-int. 69. You had not seen Mr. Ladd, had you, until he and said Stowe came together to you, as stated in your last answer?

Ans. I don't know as I ever did see him.

Cross-int. 70. On that occasion, I mean when said Stowe and Ladd came to you, as stated in your last answer but one, after some other conversation, did not said Stowe say to you, "You are the very man we want; I want you to make up your mind to go to Bristol as an evidence"?

Ans. I think it was Mr. Ladd that had over that conversation.

119 Cross-int. 71. Will you swear that it was not said Stowe who made that statement?

Ans. It was my impression now that Mr. Ladd made that statement. I may be mistaken, not charging my mind particularly.

Cross-int. 72. Did not you testify at Bristol on the occasion in May referred to that said Stowe so stated to you?

Ans. I could not tell that I did.

Cross-int. 73. When did you last see or examine your book in relation to the times when you worked on that saw-mill?

Ans. It was in May last.

Cross-int. 74. In the presence of said Ladd and Stowe, or of either of them?

Ans. I was in the bed-room where the book was, and they were in the dining-room or kitchen.

Cross-int. 75. You examined it to see when you worked on said saw-mill, did you not?

Ans. Yes, sir.

Cross-int. 76. And you did see, I suppose, did you?

Ans. I did.

Cross-int. 77. Did you show the book or any entries therein to said Ladd and Stowe, or either of them?

Ans. I told them the dates of the time I worked on said mill; whether they looked at it or not I could not say. I stepped out about that time. I have no recollections whether they examined it or not. I do not know whether they examined it or not.

Cross int. 78. You left it in the room where they were when you went out, did you not?

Ans. I think I did.

Cross int. 79. How long was you absent when you went out?

Ans. I could not tell exactly, but not long.

Cross-int. 80. How long a time was occupied in the taking of your testimony in Bristol in May last?

Ans. I do not know how long a time; I went away at noon.

Cross-int. 81. At noon of the day when your testimony ended?

Ans. Yes, sir.

Cross-int. 82. And when was it commenced?

Ans. The same day; the fore part of the day—in the morning along.

120 Cross int. 83. Did you work on that saw-mill at any time between the end of November, 1849, and the first day of March, 1850?

Ans. I do not remember. I could not tell without the book. After working through the month of November, I could not tell whether the other work I done was in 1849 or 1850.

Cross-int. 84. When did you begin to work on that saw-mill?

Ans. The 1st of November. I could not say what day of the month.

Cross-int. 85. Can you state that you did any work on or about that mill after the end of November, 1849, until it commenced running, excepting the time when the gig-wheel, as you call it, was placed in position, as stated in your tenth and eleventh answers?

Ans. I could not tell that I did.

Cross-int. 86. On what day last week did said Ladd and Stowe first see you in Hartland, and at what time in the day, and at what place?

Ans. Wednesday, a little before noon, at my house.

Cross-int. 87. How long were they with you at that time?

Ans. An hour or more; a little more than an hour perhaps. I cannot say; I did not time it.

Cross-int. 88. Did you see them or either of them again till you started to come to Hartford?

Ans. They called there on their way to the depot the next day. I was about ready to go.

Cross-int. 89. How long did they remain there before you started?

Ans. But a short time.

Cross-int. 90. What time did you arrive at Hartford?

Ans. Thursday, a little before sundown.

Cross-int. 91. Did you and said Ladd and said Stowe stop at the same hotel from the time of said arrival at Hartford till Saturday afternoon?

Ans. Yes, sir.

Cross-int. 92. Were you present on Friday and Saturday during the time that said Stowe was giving testimony in this case and attentive thereto?

121 Ans. I was here most of the time, and was mostly attentive thereto; that was my main business.

Cross-int. 93. While said Stowe was so giving testimony were you absent, according to the best of your recollection and belief, as long as fifteen minutes in all?

Ans. I should think I was more than that.

Cross-int. 94. How much more than that?

Ans. I should think double that.

Cross-int. 95. Have you remained in Hartford since Saturday afternoon?

Ans. I have not.

Cross-int. 96. Did you on Saturday afternoon or evening go with said Ladd to Bristol, and remain in Bristol till this morning and then return with him?

Ans. I did.

Cross-int. 97. Is the mill which you say you worked on in November, 1849, still standing?

Ans. It is not.

Cross-int. 98. What became of it?

Ans. It fell down partially, and the rest was torn down.

Cross-int. 99. When?

Ans. I do not know when it was that it fell down.

Cross-int. 100. Can you state the year?

Ans. I cannot.

Cross-int. 101. Can you state within three years? If so, please do so.

Ans. I do not know as I can; I can guess; that is all I can do.

Cross-int. 102. Who owned or occupied the mill at that time, if you know?

Ans. I guess William Weeden.

Cross-int. 103. Were any repairs made on said mill, so far as you know, between the time of its being built and when it fell down, as stated above?

Ans. I do not know.

Cross-int. 104. Where does said Weeden live?

Ans. In Hartland.

Cross-int. 105. Is he present?

122 Ans. He is.

Cross-int. 106. Do you know Mr. B. F. Gowan?

Ans. I do.

Cross-int. 107. Is he living; if so, where?

Ans. The last I knew of him he was living in Claremont, N. H.

Cross-int. 108. Did said Gowan own or occupy that mill at any time?

Ans. I don't think he did.

Adjourned to Aug. 3, 1875, 8.30 a. m.

HARTFORD, CONN., *Aug.* 3, 1875, 8.30 *a. m.*

Present, counsel as before.

Cross-examination continued:

Cross-int. 109. What did you see said Stowe actually do in the making of that so-called "gig" wheel?

Ans. One time I was in he was to work on the buckets, as he called them. Another time I was in he was working on the circle or rim, as I called it. Another time he was cutting out the arms. That is all I can call to recollection.

Cross-int. 110. What did you see him do in the making of the buckets?

Ans. He was cutting off with a hand axe the back sides of them (as I call it), at the lower end.

Cross-int. 111. How much were these buckets hollowed in or dug out? State as accurately as you can.

Ans. I never measured. I should think three or four inches.

Cross-int. 112. Can you tell what kind of wood they were made of?

Ans. I cannot.

Cross-int. 113. What was the distance between the inside of the circle, as you call it, and the shaft?

Ans. I do not know the exact distance; there was a space there of two or three inches.

Cross-int. 114. Do you mean that it was one, two, or three inches from the inside of that so-called circle to the shaft?

Ans. I do.

123 Cross-int. 115. How long was the gudgeon which you say was inserted in the lower end of the shaft? I mean how long was that part of the gudgeon which did not enter into the shaft?

Ans. I never measured it; it was some four or six inches; four, as near as I should guess now.

Cross-int. 116. How much was cut off from the corners of the buckets, to your best recollection?

(Question objected to for indefiniteness.)

Ans. I do not recollect anything about that part of it.

Cross-int. 117. For what purpose or use was that wheel made?

Ans. To carry back the carriage to the saw-mill.

Cross-int. 118. You have stated that you assisted said Stowe in placing or putting that wheel in position. What was done in preparing the place for it, if anything?

Ans. He had it prepared himself before. I done some little thing to it; I cannot recollect what now.

Cross-int. 119. Describe the place as it had been prepared as accurately as you can.

Ans. Whether there was timbers or scantling laid down I cannot say; there was something to hold up a few boards; that constituted the staging for us to step on.

Cross-int. 120. Refer to answer to question one hundred and fifteen, and state whether by the four inches there named you mean that part of the gudgeon which stuck out or was visible at the lower end of the shaft when the wheel was completed, and before it was placed in position to run.

Ans. I do, sir.

Cross-int. 121. Describe as accurately as you can the spot where the wheel was to be placed to run in, as it was when you and said Stowe began to put it into place.

Ans. There was a stick of timber running from towards some portion of the flume to the back, or to some foundation or anchor away from the flume; and on that timber there was a box or shoe for this gudgeon to run on.

Cross-int. 122. Describe as well as you can that shoe or box.

Ans. I think it was of wood, a little bunch or cone, like a half of an egg in form.

124 Cross-int. 123. How deep was the hole in that shoe or box into which the gudgeon was inserted?

(Objected to as tending to mislead the witness, he having testified in his last answer that it was a bunch instead of a hole.)

Ans. There was no hole there that I ever saw.

Cross-int. 124. No hole or open space in a shoe or box?

Ans. There was a circle cut round to frame a bunch or cone on the shoe, as near as I can recollect about it.

Cross-int. 125. Was this shoe, as you call it, on top of the timber or cut into the timber?

Ans. My impression is that it was cut in. I cannot recollect certain. I think it was boxed right into the timber, and keys put in to hold it.

Cross-int. 126. How high was the top of the bunch or cone above the top surface of that timber?

Ans. I could not say that it was any above, or that it was not. My impression is, as near as I can remember, that it was with the top surface of the timber.

Cross-int. 127. Did the lower end of the gudgeon rest upon and run upon the top of that cone?

Ans. It did.

Cross-int. 128. The shaft was of the same size, from its top to its bottom, was it not?

Ans. It was not.

Cross-int. 129. Wherein did it differ?

Ans. At the top.

Cross-int. 130. In what respect?

Ans. It was larger.

Cross-int. 131. Was that the only place where it differed in size?

Ans. I should think it was; I never gauged it; it looked to be the same size till you got most to the top.

Cross-int. 132. What was that cone or the top of it made of?

Ans. Wood.

Cross-int. 133. How deep was the hole or cavity in the lower end of the gudgeon which ran on that cone?

Ans. I could not tell how deep because I never measured it or gauged it, or nothing. I could guess. My best recollection is that it was three quarters of an inch.

125 Cross-int. 134. Describe as accurately as you can the size of the timber on or in which that cone was.

Ans. It was a strip of timber six or eight inches square; the length I do not know. I think it was six or eight feet long. I do not know as I ever saw the extreme length of it.

Cross-int. 135. Describe as accurately as you can the size of the flume from which the water was taken to drive that wheel.

Ans. It was some eight or nine feet wide, twelve or sixteen feet long; the depth was ten or twelve feet.

Cross-int. 136. Was it open at the top.

Ans. It was, except the saw-mill floor; there was no tight covering over it.

Cross int. 137. How near the top of the flume was the surface of the water when the gig wheel was running.

Ans. That I could not tell, but simply guess at it.

Cross-int. 138. State according to your best recollection.

Ans. It was pretty fluctuating as the water was in the brook; generally stood within two or three feet of the top.

Cross-int. 139. In giving the dimensions of the flume, as above, do you give the dimensions of the outside or inside?

Ans. Inside.

Cross-int. 140. Was the water which drove the gig wheel taken from the end or side of the flume?

Ans. I cannot recall to memory which.

Cross-int. 141. Was the gate on the inside or outside of the flume?

Ans. On the inside, my impression is.

Cross int. 142. How far above the bottom of the inside of the flume was the spout which conducted the water to the gig wheel?

Ans. I could not tell.

Cross-int. 143. Did you assist in putting the spout in?

Ans. I did not.

Cross-int. 144. Did you see it put in?

Ans. I did not.

Cross-int. 145. Did you see it after it was put in?

Ans. I did.

Cross int. 146. You used and run that saw-mill, did you not?

126 Ans. I did.

Cross-int. 147. State according to your best recollection how far above the inside of the bottom of the flume the upper end of the spout was which conducted the water to the gig wheel.

Ans. Somewhere from two to five feet. I cannot tell certain; simply guess.

Cross-int. 148. Was the open end of the spout, I mean the end in the flume, always wholly under water when the gig wheel was running?

Ans. I could not tell you; I never looked to see; I always supposed it was.

Cross-int. 149. After you and said Stowe had set the gig wheel, as stated, how soon, or when for the first time, did you see it when in running condition?

Ans. It might have been a fortnight or three weeks; I could not state the time exactly.

Cross-int. 150. Did you at that time, or at any time, examine or see the lower end of the spout as to its connection with or relation or position to the gig wheel?

Ans. I never did. I never went down under there to examine it particularly.

Cross-int. 151. After the spout was put in its place, did you ever go to that gig wheel or so near it that you could see where the lower end of the spout was in its relation to the wheel?

Ans. No nearer than I could see from above; never went down to examine it after I helped raise the wheel.

Cross-int. 152. Was there any cover over the top of that gig wheel after it was set?

Ans. I do not recollect that it was covered up anything more than the rim.

Cross-int. 153. Did you receive last week, or at any time between last May and last week on Tuesday, any letter or request, in writing or otherwise, to be at New Britain or Bristol last week on Monday or Tuesday?

Ans. I received a letter, sir; I could not say on what date. I was requested to come.

Cross-int. 154. For what purpose did that letter state you were wanted?

127 Ans. He said as a witness, I think.

Cross-int. 155. As a witness about what?

Ans. I could not say as he said; the contents of the letter are gone from me.

Cross-int. 156. In what case did you give the testimony in May before spoken of?

Ans. The case of the National Water Wheel Company, as I supposed.

Cross-int. 157. Have you seen, or read, or heard read, or been told, the testimony you then gave, or any portions thereof, within a week previously to this time?

Ans. I have.

Cross int. 158. You have seen and read a printed copy of it, have you not?

Ans. I have seen it and I have read part of it. I don't think I read it all. I can't rememb'r now.

Cross-int. 159. When did you last see that printed copy?

Ans. Sunday.

Cross-int. 160. When did you first see it?

Ans. Sunday.

Cross-int. 161. It contained also the printed testimony of said Stowe in that case, did it not?

Ans. I didn't read it, but it did; I did not read it, only the heading of it. I did not examine it only a minute or two any way.

Cross-int. 162. I now give in several questions what I understand to be extracts from the testimony given by you in May, as aforesaid: (*a*) "Int. 5. To what mill do you allude, and when did you begin work upon it, and for how long did you and Mr. Stowe work together upon the mill? Ans. To the Spear saw-mill in Hartland, Vt. I began work on the mill Nov. 1, 1849. Mr. Stowe and I worked together on the mill pretty much through that month. I notice upon my book that we worked together three days in the year 1850; I think it was 1850." Did you testify as above stated?

Ans. I don't think I did.

Cross-int. 163. (*b*) "Int. 8. How long before the mill commenced to run was it that you worked together for the three days alluded to, and what was the character of the work upon which you were employed. Ans. It was putting in the wheel. The wheel was attached to an upright shaft. I think that was in the month of March, too." Did you testify on that occasion as above quoted?

128

Ans. I think it must be so.

Cross-int. 164. (*c*) "Int. 16. You may describe the wheel, commencing at the shaft, if you please, and describing each part outward and downward in its turn. Ans. The shaft was about ten feet long; at the bottom end of the shaft spokes were mortised through, some four spokes I should say, or arms, whatever you call them. On the out end of these arms a rim was built of boards or plank, round in shape. I cannot recollect how thick the rim was. The rim was some four or six inches wide; as near as I can recollect, I should think the buckets were put on to every arm with a shoe shape. On the outside there was a rim put on—of iron, I should think it was. It was put on the lower part of the buckets." Did you testify as above quoted?

Ans. I don't recollect exactly. I should presume likely that I did; but I cannot say.

Cross-int. 165. (*d*) "Cross-int. 32. Relate what was said between you about it, preserving the order of the conversation. Ans. He and Mr. Ladd drove into the lot where I was planting potatoes. I did not recognize Mr. Stowe at first. He said, 'Sumner, you don't know me, do you?' I said, 'I do not; I do not recognize you.' He says, 'Don't you remember of helping me build a saw-mill, the Spear mill, so-called,

down west of here?' I says, 'Yes, John Stowe.' Then came the usual greetings. I asked him what he was up here for. He said, 'To see you, principally.' Then he says, 'Do you remember anything about that wheel I put in?' I says, 'Yes, I remember something about it.' He said, 'I want you to go on and describe it, as near as you can recollect.' I did so. I said, 'Yes, I can describe it, as near as I can recollect.' I described the shape of the shoe. He said, 'The bucket, as we called it,' turning to Mr. Ladd. He said to me, 'You are the very man we want. I want you to make up your mind to go to Bristol as an evidence.' I asked him on what? He said, 'On the wheel,' and referred to Mr. Ladd. I told him I could not very well leave. Mr. Ladd said he would pay me well for my time. I agreed to go." Did you testify as above quoted?

129 Ans. I think I did.

Cross-int. 166. (*e*) "Cross-int 37. Where was the spout? Ans. Under the mill. Cross-int. 38. Where, with reference to the wheel, was the spout; was it over, under or on the side of the wheel? Ans. As near as I can recollect, part was over and part on the side. Cross-int. 39. Are you certain where it was? Ans. That is as near as I can locate it from remembrance. Cross-int. 40. Are you certain? Ans. I am not. Cross-int. 41. Did the water flow downward from the spout into the buckets, or horizontally from the spout into the buckets? Ans. Downwardly, I should call it. Cross-int. 42. What was the shape of the spout? Ans. It was a square box, as near as I can recollect, square plank put together." Did you testify as quoted above?

Ans. I could not say certain as I did.

Cross-int. 167. After giving your answer to Cross int. 162 did not Mr. Mitchell with my consent hand to you what purported to be a printed copy of the testimony you gave at Bristol, as aforesaid, for the purpose of refreshing your recollection? And since you gave your answer to said Cross-int. 162, have you not carefully read and compared the printed copy with the quoted parts of all the subsequent interrogatories? And have not all of the extracts as read by the examiner agreed with the said printed copy?

Ans. Mr. Mitchell did hand me such printed copy. I have compared the printed copy with the quoted parts of all the subsequent interrogatories, and all the extracts as read by the examiner have agreed with said printed copy.

Cross-int. 168. (*f*) "Int. 52. You say in answer to Cross-int. 28, that you last examined the wheel in 1850. State whether you used the wheel after that date; and, if so, when? Ans. When I examined the wheel was at the time of putting in the wheel; I ran the wheel three days some three years after when the mill came into the second man's control. His name was B. F. Gowan." Did you testify as above quoted, and does the quotation agree with said printed copy?

Ans. I should think I so testified. I have since examined my books and find that the three days' work were done previous to this mill's being built. The quotation does agree with said printed copy.

130 Cross-int. 169. When did you examine your books, as stated in your last answer?

Ans. It was in May, after the middle of May last.

Cross-int. 170. The examiner will now please read to you the Cross-int. 162, and while reading please compare the quotation with said printed copy, and state whether it agrees therewith.

Ans. It does.

Cross-int. 171. At the time when you testified at Bristol, as aforesaid,

had you any of your books with you, and did you take any of them from Hartland?

Ans. I did not.

Cross-int. 172. How long were you in Bristol on that occasion?

Ans. From the fore part of the day till noon. I do not know what time of the day we got there; seven or eight o'clock; eight o'clock perhaps.

Cross-int. 173. Who came with you from Hartland to Bristol?

Ans. Mr. Stowe and Mr. Ladd.

Cross-int. 174. Has any person other than Mr. Stowe and said Ladd been at your house in Hartland this year and had any conversation with you touching any of the matters referred to in this deposition?

Ans. There has not.

Cross-int. 175. Who was present, if any one, when you examined your books as stated in answers to Cross-int. 168 and to Cross-int. 169?

Ans. There was no one; I do not know but my wife might have been in the room.

Redirect resumed:

Int. 176. You state in answer to cross-int. 52 that Mr. Ladd got you here to testify, and afterwards in answer to cross-int. 59 that you did not know what you were coming for; will you please explain in what sense you did not understand for what purpose you were coming?

Ans. I do not know for what I had got to testify to.

Int. 177. Do you mean that you did not understand that it was about the wheel to which you have testified?

131 Ans. I supposed it was that.

Int. 178. In your answer to cross-int. 108 you state that you don't think that Gowan owned the Spear Mill at any time; you afterwards state that you testified otherwise in May; and further, that you have found since you testified in May that the three days' work were done previous to the Spear Mills being built; will you please explain fully?

Ans. This Mr. Gowan owned a mill standing on the same site of the Spear Mill up to within a year of the time of the building of the Spear Mill. I worked for him three days, and that charge was put on to the same page of the Spear & Williams charges in my book. When I was reading it over I coupled this charge in with the Spear & Williams charges, and did not notice the line which was drawn between the charges. It was a sort of a day-book. When I went home from Bristol I was looking at my book and discovered my mistake.

Int. 179. Then, if I understand you now, Mr. Gowan never owned the Spear & Williams Mill, to your knowledge; am I right?

Ans. He never did.

Int. 180. In answer to cross-int. 156 you state that you gave your testimony in May in the case of the National Water Wheel Company, as you supposed; do you know who the other party was?

Ans. I do not.

Int. 181. Do you know whether the other party was the present opponent of the National Water Wheel Company, to wit, the Swain Turbine and Manufacturing Company?

Ans. No, sir; I do not.

Int. 182. State whether or not the spout to which your attention has been called in cross-examination was covered on top.

A. It was.

Int. 183. Which end was the broadest, the end towards the wheel or the end towards the flume?

(Question objected to as implying what has not been proved or admitted, and as suggesting to the witness that the spout is of different form from that to which he has in effect testified.)

Ans. The end towards the flume.

Int. 184. In giving your testimony before the magistrate, in
132 May, were you asked, with reference to the words "shoe shape," which occur in your answer to question 16, already placed in evidence in your cross-examination, viz: "Int. 21. What do you mean by 'shoe shape,' of the bucket?" and did you answer, "I mean the lower end to turn up, dishing in the middle"?

Ans. I think I did. I did.

Int. 185. Please state if on that examination in May you testified as follows: "Int. 48. In your answer to cross-int. 41 you state that the water flowed downwardly from the spout into the buckets; do you, in that answer, refer to the general direction of the flow of the water from the flume to the wheel? (Objected to as leading.) Ans. I do, from the flume to the wheel. Int. 49. At the precise point at which the water entered the buckets, did it pass beneath the rim around the top of the buckets, or did it pass over the rim? Ans. It passed under the rim."

Ans. I did, sir.

Int. 186. Have your books, or any of them, ever been seen by defendant's counsel, or either of them?

Ans. No, sir.

Int. 187. You testified that Mr. Ladd stated he would pay you well; what have you asked him for your services as a witness, and what has he paid or agreed to pay?

(Objected to as irrelevant, incompetent, and inadmissible.)

Ans. He has agreed to pay me $3 per day and expenses, and has paid me most of it.

Int. 188. You state in answer to cross-int. 110 that you saw Mr. Stowe cutting off the back sides of the buckets, "as I call it," at their lower ends; afterwards in your testimony occur cross-int. 116 and answer, as follows, viz: "How much was cut off from the corners of the buckets, to your best recollection? (Question objected to for indefiniteness.) Ans. I do not recollect anything about that part of it." State whether you understood the second question to refer to the same portion of it that the first did.

Ans. I do, if I understand it right.

Int. 189. I will endeavor to make you understand it by asking if you meant to be understood, in your reply to cross int. 116, that you
133 do not recollect anything about the cutting off of the "back sides" of the buckets at the lower ends, as you have previously stated in reply to cross-int. 110?

(Objected to as leading and as suggesting the answer desired.)

Ans. No, sir, I do not mean to be understood so.

Int. 190. Are you any way interested in this case?

Ans. I am not, sir.

S. B. SMALL.

Attest:

EDWIN E. MARVIN,
U. S. Commissioner.

United States circuit court, district of Massachusetts. In equity.

THE SWAIN TURBINE AND MANUFACTURING Company
v.
WILLIAM HUNTLEY.

It is stipulated that the time for taking testimony by the defendant shall be extended for fifteen days from date without prejudice to a further extension, if the defendant shall be unable with due diligence to take his testimony within said period; time for rebutting testimony to be extended accordingly. Also that the testimony of William Weeden and N. B. Luce, both of Hartland, Vt., shall, if taken, have the same weight and effect as if the names and residence of said witnesses had been given in the answer as required by law, and that the answer may be amended without motion in accordance herewith.

JOHN S. ABBOTT,
For Complainant.
C. E. MITCHELL,
For Defendant.

HARTFORD, CT., *Aug.* 3, 1875.

134 EVIDENCE FOR DEFENDANT.

Taken pursuant to the sixty-seventh rule of the Supreme Court of the United States in equity, as amended, before me.

J. HENRY HILL,
Examiner.

Present, John S. Abbott and H. W. Boardman, esq's, of counsel for complainant; C. E. Mitchell, esq., of counsel for defendant.

Deposition of William Weeden.

Direct examination by C. E. MITCHELL, Esq., of counsel for defendant:

Int. 1. What is your name, age, residence, and occupation?

Ans. My name is William Weeden. My age is fifty-four. I reside in Hartland, Vt., and am a farmer by occupation.

Int. 2. How long have you resided in Hartland, Vt.?

Ans. Well, I moved into Hartland the last of April last. I have resided there before.

Int. 3. What portion of your life have you resided in Hartland?

Ans. As near as I can tell, twenty-five—yes, nearly thirty years.

Int. 4. Do you know if there was, since the year 1850, a saw-mill in said Hartland, Vt., known as the Spear & Williams saw-mill?

Ans. I do. There was.

Int. 5. Who bought said Spear & Williams saw-mill from Messrs. Spear & Williams, if you know?

Ans. I bought the mill.

Int. 6. In what year did you buy the mill?

Ans. In 1863.

Int. 7. How many and what water-wheels, if any, were used in connection with said mill when you purchased the same in 1863.

135 Ans. There were two wheels; one was an upright shaft with

buckets attached, and the other was what was called a breast wheel or fluted wheel.

Int. 8. When did you first have your attention drawn to the wheel with an upright shaft, of which you have spoken?

Ans. I don't know as I could tell; it was somewhere in 1853 or 1854.

Int. 9. By what name, if any, was this upright wheel then called?

(Question objected to as hearsay, irrelevant, and incompetent.)

Ans. It was called the Stowe wheel.

Int. 10. State whether or not you saw the wheel more than once before you purchased the mill; and, if yea, with what frequency, as near as you can state, and give any occasion that now occurs to you.

Ans. I have, several times; some two or three times a year from that time to 1857 or 1858. Most of the time it was on visits. One time in particular I helped to repair the flume.

Int. 11. How long did you own the Spear & Williams saw-mill after you bought it in 1863?

Ans. Five years.

Int. 12. How long, to your knowledge, did the wheel with the upright shaft which you have spoken of as known in 1853 or 1854 as the Stowe wheel remain in that mill?

Ans. From that time till I sold it; in 1868.

Int. 13. Will you please describe the "Stowe wheel," referred to in the foregoing answers?

Ans. It was an upright shaft—a perpendicular shaft, with buckets at the lower end. There were arms attached to the shaft—there were four arms certain, might have been possibly six; I never counted them—with a rim on the upper side of the arms five or six inches wide. The arms, as near as I can judge by the looks of them—I never measured them—eight or nine inches long from the shaft; and there were buckets attached to the shaft about the same width as the rim, and some eight or ten inches long. At the lower end of the buckets was an iron band some inch or inch and a half wide—an inch wide certain. The buckets were made out of thick plank or blocks of wood, dug out on one
136 side, scolloped out, the other side on a curve, rounded off on the edges. The inside edge of the bucket run from the crown down to the lower edge of the band; the outside edge from the crown down to the band.

Int. 14. You say that there were arms attached to the shaft; were the buckets attached directly to the shaft, or through the medium of the arms?

(Question objected to as suggestive and leading.)

Ans. Attached to the arms.

Int. 15. What was the number of buckets compared with the number of arms?

Ans. There were twice as many buckets as there were arms.

Int. 16. Please explain, generally, the relation of the buckets to the arms.

Ans. They were attached to the arms on what was called the back side of the arms, the rim. The arm was cut out to fit the bucket; the bucket was also cut out to fit the arm; the arms were, at the outer end, shaved off or rounded to the outer edge of the buckets. The alternate buckets were fastened to the crown and band.

Int. 17. Which was the farthest forward under the rim of the wheel, the outer edge of the bucket or the inner edge of the bucket? and in

answering this question please to understand I mean by "forward," the direction in which the wheel was moving when in operation.

Ans. The outer edge.

Int. 18. What distance, in inches?

Ans. Well, I should judge about three or four inches; it might have been more.

Int. 19. What was the position of the bottom edge of the bucket (I mean the portion below the top of the band) as compared with the inner edge of the bucket?

Ans. It was cut away so as to come on the same line as the inner edge.

Int. 20. Do you mean the same radius line?

Ans. Yes.

(Defendant puts in evidence a model of wheel marked Defendant's Exhibit No. 3, J. Henry Hill, Ex'r.)

137 Int. 21. Please examine carefully the Defendant's Exhibit 3, being the block model with brass band, before you, and compare the same with the "Stowe wheel," so called, which you saw in the Spear & Williams mill, in the years 1853 or '54, and thereafter, and point out all the differences that exist between said model and said wheel.

(Complainant's counsel objects to the introduction of the Exhibit No. 3, as improperly introduced, and objects to this interrogatory as incompetent.)

Ans. The difference is that the arms were under the rim in the Stowe wheel instead of on the top of the rim, and the shaft came down lower than it is here, I should think. The ends of the arms were shaved off to a point, to fit with the buckets; and I can't say as the buckets were hollowed or scolloped out as much as they are here. If this was of the same size I could tell nearer.

Int. 22. I understand from your answer to Int. 18, that the buckets were hollowed or scolloped out in the Stowe wheel enough to make the outer edge of each bucket some three or four inches, and perhaps more, farther forward than the inner edge of each bucket. Am I right?

(Question objected to as leading, suggestive, and explanatory to the witness.)

Ans. I should say you was, if I understand it right.

Int. 23. Under what head of water did the "Stowe wheel" work which you have referred to?

Ans. Well, I should think from six to eight feet.

Int. 24. Do you refer, in your last answer, to the height of flume or the height of water in the flume?

(Question objected to as suggestive and leading.)

Ans. Well, I should think the flume was eight feet; the water was not far from the top at that time.

Int. 25. How was the water conducted to and into the wheel?

Ans. It was taken from the flume by a box extending from the flume to the wheel, down a descent, under the rim of the wheel, onto the buckets.

Int. 26. Describe the box referred to in your last answer.

Ans. The shape of the box was a square form, wider next to the flume; well, I should judge a foot and a half wide next the flume;

138 next the wheel I shouldn't think it was more than six, or eight inches at the outside. The depth of the box I don't know as I could tell; I should think that way it was all the way alike—wide enough to fill between the rim and the band of the wheel.

Int. 27. In what way was the box adjusted to the wheel?

Ans. There was something of a curb, I think, next to the wheel, extending part way round; the box was fastened to that. I don't know as I can express it so that you can understand it; one side of the box, where it came upon the wheel, was longer than the other—I should call it the outside.

Int. 28. What was the practical effect of this construction upon the possibility of the water under the pressure of the head escaping without passing through the wheel?

(Question objected to, the witness not having been shown to be an expert or competent to answer such an inquiry.)

Ans. I don't understand the question.

Int. 29. As that box was constructed and adjusted to the wheel, as you have described, was there any way for the water to escape from the box without going through the wheel?

Ans. There wasn't any.

Int. 30. For what purpose was the upright wheel referred to and described used?

Ans. For running back the saw-mill carriage.

Int. 31. How long was it used, to your knowledge, for that purpose, and what was its character in point of power and efficiency?

(Last inquiry in this interrogatory objected to, the witness not having been shown competent to answer it, and not being an expert.)

Ans. Some six or eight years. I couldn't tell as to its power and efficiency.

Int. 32. I don't ask for the percentage of the water which it would utilize, but in general, whether it was a good one or not?

Ans. I should call it a good wheel for that place.

Int. 33. Was the mill used for power purposes during your ownership of it?

Ans. It was not.

Int. 34. Do you know what person was referred to in the term "Stowe wheel," by which the wheel in question was called?

139 (Question objected to as irrelevant and asking for hearsay.)

Ans. The man who built the wheel—a man by the name of Stowe.

Int. 35. Please give the whole name of the builder, if you can.

(Question objected to unless answered by the witness of his own knowledge.)

Ans. John L. Stowe.

Int. 36. Do you know said John L. Stowe; and, if so, how long have you known him, and where does he now reside?

Ans. I do know him. The first that I was acquainted with him was in the fall of '49, the day that the mill was raised. He now resides in Newark, New Jersey.

Int. 37. To what mill do you refer in your last answer?

Ans. The Spear & Williams mill.

Int. 38. The same one that you subsequently bought?

Ans. It was.

Int. 39. Do you know who built that mill; and, if so, who?

Ans. Stowe was one of the head workmen. Sumner B. Small, of Hartland, worked for them.

Int 40. Are you interested in the pending case?

Ans. I am not.

Cross-examination by JOHN S. ABBOTT, Esq., counsel for complainant:

Cross-int. 41. Where did you reside in the summer and fall of 1849?

Ans. I made it my home at my father's, in the town of Reading, Vt.

Cross-int. 42. How far was that from the place where the said Spear & Williams mill was erected?

Ans. About seven miles.

Cross-int. 43. Did you work on that mill when it was being built?

Ans. Nothing, only help raise it.

Cross-int. 44. Were you at the place where it was built, and while it was being built, until the day it was raised?

Ans. Well, I was there two or three times. I worked for a
140 man by the name of Spear, right in sight of the mill, on a farm, by day's work.

Cross-int. 45. How long during that summer and fall, and before the mill was raised, did you work for that Mr. Spear?

Ans. I can't tell the number of days; it was late in the fall.

Cross-int. 46. State the number of days, to your best recollection.

Ans. Well, from six to ten days.

Cross-int. 47. In the answer to the thirty-sixth interrogatory you say you have known Mr. John L. Stowe since the day that mill was raised; and that, I suppose, was the first time you had seen him, was it not?

Ans. No; I had seen him a few times before, but not to be particularly acquainted with him.

Cross-int. 48. Please refer to the thirty-sixth interrogatory and answer, and state why you make that answer, if you had known him before that day.

Ans. I think that was the first time I was in his house. After the raising we went to his house for refreshments.

Cross-int. 49. Are you certain you went to his house that day?

Ans. It was a house that he lived in. I don't know as he ever owned a house in his life. It was where he was residing at that time.

Cross-int. 50. How far was that house from the mill, and in what direction?

Ans. I should judge about thirty rods nearly; and his house was nearly west of the mill, or a little south of west.

Cross-int. 51. Where had you seen said Stowe before the day when the mill was raised?

Ans. At work there on the mill, framing of it.

Cross-int. 52. Had you seen him doing anything else before the mill was raised?

Ans. I can't say that I ever did.

Cross-int. 53. When did you next see him after the mill was raised?

Ans. I don't know as I could tell exactly when. I used to see him frequently after that.

141 Cross-int. 54. Where, and doing what?

Ans. Well, I see him in several places. I saw him once in St. Johnsbury, and I see him once in Hartland. At the time I saw him in St. Johnsbury he was putting in a wheel into a saw-mill.

Cross-int. 55. When did you see him in St. Johnsbury?

Ans. I don't know as I can tell the year now; somewhere in 1856, nearly. He was then living in St. Johnsbury.

Cross-int. 56. Did you see said Stowe between the time when that mill was raised and the first day of June then next following?

Ans. It is my impression that I did see him a few times during that winter, but can't say positively.

Cross-int. 57. Can you call to mind anything that you saw him do after that mill was raised and before the following June?

Ans. I don't know as I can. There was one time, but whether it was in that time I cannot say; he was getting out a shaft for another man, Mr. Jenne; he had a crank fastened to the shaft, and the man that he was building it for was turning it. It was about that time. It was the first part of my acquaintance with him; but whether it was in that time I can't tell, or whether it was in the next fall or winter.

Cross-int. 58. Where did you see him so employed?

Ans. There where he lived at the time the mill was raised—at the house.

Cross-int. 59. I infer from your last answers that you never saw said Stowe when actually working upon the upright wheel which drove the carriage back in that saw-mill; am I right?

Ans. I never saw him at work on it.

Cross-int. 60. And you never saw the wheel, or any part of it, until about 1853 or 1854, named in your eighth answer, did you?

Ans. Well, I think I have, but not to notice it.

Cross-int. 61. When did you first see it?

Ans. I think it was in the fall of 1851. I was at work for George Spear, a son of this Spear. I worked then on his farm a month and a half, I should think. Mr. Spear that I worked for—George Spear—was sick.

Cross-int. 62. Then you have no actual personal knowledge that said Stowe built said upright wheel, have you?

142 Ans. No; I don't know as I have—anything more than general opinion.

Cross-int. 63. Were you ever in Newark, N. J.?

Ans. I never was.

Cross-int. 64. Then, of course, you have no personal knowledge that said Stowe lives there, have you?

Ans. Nothing more than what he says himself—that he lives there.

Cross-int. 65. To whom did you sell the Spear & Williams saw-mill?

Ans. His name is Napoleon B. Luce. I sold the wheel and running part, etc., to him, and the frame to another man.

Cross-int. 66. While you owned that mill did you work or run it yourself?

Ans. I did not.

Cross-int. 67. Did you work or run it any part of the time?

Ans. I did not.

Cross-int. 68. What part of each year, or about what portion of each year, while you owned the mill, was it operated, and during what months, if you can state?

Ans. It never was in a running condition while I owned it.

Cross-int. 69. What was the difficulty?

Ans. The dam washed out before I bought it.

Cross-int. 70. How long before?

Ans. Two years before, certain.

Cross-int. 71. How much longer than two years, according to your best recollection?

Ans. Well, I went on to the place, I think, about the 1st of May, 1861. The dam was gone then. Whether it went out that spring, before I went there, I cannot say.

Cross-int. 72. When the dam went out were the flume and the box referred to carried out or destroyed?

Ans. They were not.

Cross-int. 73. Were they injured?

Ans. I think not.

Cross-int. 74. Referring to your answer to cross-int. 65, state which of the wheels you sold to said Luce and what he did with it, if you know.

143 Ans. I meant to be understood, both the wheels—all the wheels there were in the mill. I can't tell what he done with it, except by hearsay.

Cross-int. 75. Where did said Luce then reside, and where is he now, if you know?

Ans. He then resided in Hartland, and I don't know but he does now. I don't know of his living anywhere else.

Cross-int. 76. When and where did you last see him?

Ans. I can't tell when; but the last time I did see him was over at Hartland Four Corners; it was some time this summer.

Adjourned.

AUG. 11, 1875.

Cross-int. 77. After the freshet which carried out the dam some time prior to May, 1861, did water run into the flume?

Ans. It did not.

Cross-int. 78. How much did said Luce pay, or agree to pay you, for the wheels and other materials connected with that saw-mill which you sold him?

Ans. Twenty-five dollars.

Cross-int. 79. Did you assist him in removing the wheels or any of the materials sold?

Ans. I did not.

Cross-int. 80. Were you present when they or any of them were removed?

Ans. I was not.

Cross-int. 81. To what place was the said upright wheel removed, according to the information you have?

Ans. Bridgewater, Vt.

Cross-int. 82. And to what part of Bridgewater?

Ans. I couldn't tell.

Cross-int. 83. Did said Luce then reside in Bridgewater?

Ans. I think not.

Cross-int. 84. Did you hear the name of the person to whose place in Bridgewater it was said that wheel was to be moved?

Ans. I don't recollect as I ever did.

Cross-int. 85. In what part of Hartland does said Luce now

144 reside? About how far and in what direction from the place where said mill stood?

Ans. Well, it is in the east part; I can't tell which place, whether "Three Corners" or "Four Corners." The direction is about east. Four Corners is about four miles; Three Corners one mile farther.

Cross-int. 86. What is and what has been the business of said Luce, so far as you know or are informed?

Ans. Well, he is a general day laborer, I should call it, or jobber.

Cross-int. 87. Do you know Thomas Cobb?

Ans. I used to know him; he is not living now.

Cross-int. 88. Please give the Christian name of Mr. Spear's son, spoken of by you in your answers yesterday.

Ans. George.

Cross-int. 89. Is he living now; if so, where?

Ans. He is; in Hartland, Vt. He makes it his home with his two

sons. One of them lives about half a mile west from the saw-mill—where it was—and the other about three miles, mostly east.

Cross-int. 90. With which of them is he now living?

Ans. When I came away he was with the one farther east.

Cross-int. 91. Was said George Spear familiar with the said upright wheel? Did he ever examine it, to your knowledge or information?

Ans. I can't say as he was; I don't know as he ever examined it.

Cross-int. 92. In answer to the fifty-fourth cross-interrogatory, you say that you saw said Stowe at work in St. Johnsbury upon a wheel; what kind of wheel and for whom?

Ans. I can't say what kind of a wheel it was or who he was putting it in for; it was in a mill running a circular saw, turning lathe, etc.

Cross-int. 93. Can you give the names of any other persons besides said Stowe and said Small whom you saw at work on the Spear & Williams mill when it was being built?

Ans. I don't know as I can, it was so long ago.

Cross-int. 94. State fully what examination you made of the said upright wheel in 1853 or in 1854, mentioned in your eighth answer.

145 Ans. Well, I was looking it over for curiosity's sake, to see it run; and I noticed it was built different from other wheels for that purpose that I had seen.

Cross-int. 95. What other wheels built for that purpose had you then seen?

Ans. The wheel that was in the saw-mill most where I lived; within a few rods from my house where I lived.

Cross-int. 96. What kind of a wheel was that?

Ans. A wheel with an upright shaft with buckets, with the lower end fastened to the shaft, either mortised in, I think they were mortised in; I won't be positive about that—I don't know, come to think it over, but there were arms mortised in and floats fastened to them.

Cross-int. 97. When you examined the said upright wheel, as stated in your answer to the ninety-fourth cross-interrogatory, who were present?

Ans. Don't know as I could tell.

Cross-int. 98. Did you ever examine it at any other time? If so, state when, what examination you made, and who were present.

Ans. I think I have. I can't tell when; it was in either 1856 or '57. The flume had got out of repair and I helped repair it. I think one man's name was Jonas Tarbell, and another man's name was Elbridge Dodge, and another man's name was Allen; I think that's the name; I wont be certain; I am not acquainted with him. I was looking the wheel over to see if it was in running condition.

Cross-int. 99. Did you ever see that upright wheel in operation, excepting at the time mentioned in your ninety-fourth answer?

Ans. I think I have.

Cross-int. 100. When, and for how long time?

Ans. It was after I worked on the flume; I can't tell whether it was one or two years after; I can't tell as to that. I was in the mill one day, particularly, when it was running; well, I might have been in there an hour, or an hour and a half.

Cross-int. 101. And did you go to the said upright wheel on that occasion?

Ans. I did.

146 Cross-int. 102. After the dam was carried out, as stated by you, and between that time and the time when you sold said upright wheel, did you examine it?

Ans. Well, I think I have.

Cross-int. 103. Several times?

Ans. Can't say as to that; I recollect one time.

Cross-int. 104. At that one time did you examine it pretty carefully?

Ans. Not very particular.

Cross-int. 105. Did you look over that upright wheel with said Luce at or before the time when you sold it to him?

Ans. I did not.

Cross-int. 106. To whom did you sell the frame, and where does he live?

Ans. I believe his name was Alvin Dutton; I know it was. He is not living.

Cross-int. 107. State the thickness or the diameter of the shaft of that upright wheel, as accurately as you can.

Ans. About eight inches.

Cross-int. 108. Did you ever measure it or see it measured?

Ans. I have not.

Cross-int. 109. Was it of the same size from its top to its bottom?

Ans. I should think it was a little smaller at the top than the bottom.

Cross-int. 110. State, as accurately as you can, the distance between the shaft and the inner edge of the rim.

Ans. Some three or four inches.

Cross-int. 111. On what did the lower end of the shaft rest when the wheel was in operation?

Ans. Well, I can't tell whether it stood on an iron; I think it was an iron; an iron fastened to a stick of timber: I think the iron rounded over some way, a little higher in the centre; I think that was the way.

Cross-int. 112. How large was that stick of timber?

Ans. Some six or eight inches through.

Cross-int. 113. Measuring crosswise or up and down?

147 Ans. I should say it was nearly square.

Cross-int. 114. How near or close to that timber was the lower end of the shaft when the wheel was running?

Ans. Well, I should think nearly an inch from the shaft to the iron it run on.

Cross-int. 115. You mean that you think it was nearly an inch from the lower end of the wooden shaft to the upper end or surface of the iron it run on, do you?

Ans. Well, I should think it was all of that; it might possibly have been more, I never measured it; I only judge from the looks of it.

Cross-int. 116. Was that iron on which the wheel run sunk into the timber?

Ans. My impression is it was not

Cross-int. 117. Are you certain?

Ans. I am not.

Cross-int. 118. State as accurately as you can the distance between the lower end of the wooden shaft and the upper surface of said timber.

Ans. I don't know as I can tell exactly, or anywhere near. It might be two inches and it might not be so much or more.

Cross-int. 119. How near to the upper surface of that timber did the lower edge of the band run when the wheel was in operation?

Ans. Well, it might have been an inch; I could see under it, between the band and the timber. I couldn't tell whether it was an inch or an inch and a half.

Cross-int. 120. How were the upper ends of the buckets fastened?

Ans. I don't know whether they were fastened by spikes or bolts.

Cross-int. 121. And to what were they fastened?

Ans. To the arms and rim.

Cross-int. 122. Do you mean that a part of them were fastened to the arms only, and a part of them to the rim only?

Ans. Well, those that were fastened to the arms I never noticed whether they were fastened to the rim, too, or not; the others were only fastened to the rim.

148 Cross-int. 123. How thick was each of their buckets in the thickest part?

Ans. I should judge they were two inches.

Cross-int. 124. Now, suppose a straight edge was placed across one of these buckets from the inner to the outer edge thereof, opposite where it was hollowed in the deepest, and you were there to measure in order to get the depth, state how far the bucket was scolloped or dug out, accurately as you can?

Ans. Well, I should judge two inches.

Cross-int. 125. Was the outer edge of each bucket from the rim down to top of the band straight?

Ans. I think they were.

Cross-int. 126. And was the inner edge also straight from the rim till you get down exactly opposite the band?

Ans. I don't think it was quite.

Cross-int. 127. Are you certain that it varied at all from a straight line till you got down to a point exactly opposite to—that is, on a horizontal line from—the upper edge of the band?

Ans. Well, I think it commenced to bend before it got to the upper edge, as near as I can recollect.

Cross-int. 128. Do you recollect that it did so commence?

Ans. I can't say positively, but I should judge that it did.

Cross-int. 129. How far above the upper edge of the band do you judge that the inner edge of the bucket began to vary from a straight to a downward line?

Ans. I should judge about an inch, as near as I can recollect.

Cross-int. 130. How many buckets were there in that wheel?

Ans. There were eight, certain.

Cross-int. 131. In your answer to the twenty-seventh interrogatory you say "there was something of a curb stood close to the wheel extending part way around." How close to the wheel? What was the distance between the inside of that curb to the outer side of the wheel?

Ans. I couldn't tell the distance—it lay close to the wheel, so that the wheel could just run round without touching it.

Cross-int. 132. In that twenty-seventh answer you spoke of a curb as "extending part way around;" what part of the way? State as accurately as you can.

149 Ans. Well, not more than half-way.

Cross-int. 133. Was it more than a quarter of the way?

Ans. I think it was.

Cross-int. 134. Do you feel certain that it was?

Ans. I do.

Cross-int. 135. Was it more than a third of the way round?

Ans. I think it was all of that; it might possibly have been a little more.

Cross-int. 136. In that same twenty-seventh answer you say, "the box was fastened to that"; to what part of that curb was the box fastened? How much, or what portion of the curb, was on one side of the box, and how much or what portion was on the other side; or, in

other words, was the box fastened at the middle of this portion of a curb? And if not at the middle or centre, at what part of it?

(Question objected to by Mr. Mitchell, as implying that there were portions of the curb on each side of the box, and thereby tending to mislead the witness.)

Ans. It was fastened to the part of the curb nearest the flume. All the curb was on one side of the box. It extended from the end of the box round.

Cross-int. 137. In what way was the box fastened to that part of the curb?

Ans. Well, it was either spikes or bolts; I couldn't tell which.

Cross-int. 138. Did the lower side of the box extend under the wheel?

Ans. I don't think it did.

Cross-int. 139. What was the distance from the top of the rim or crown to the lower edge of the band?

Ans. Well, I should think from eight to ten inches; I should think it was more than that—nearly a foot. When I said from eight to ten inches I thought the question meant to the top of the band.

Cross-int. 140. Have you ever had occasion to ascertain or to learn the meaning of the word radius?

Ans. I don't know as I really have; I take it, it is a straight line from the centre, as near as I can express it.

Cross-int. 141. A straight line from the centre of what, and ending where?

Ans. Well, from the centre of anything to the outside.

Cross-int. 142. Were you at Hartford last week, and week before last?

Ans. I was.

Cross-int. 143. Were you present while said Stowe, and also while said Small, gave testimony before E. E. Marvin, esq., in this case?

Ans. I was.

Cross-int. 144. Did you come down from Hartland to Hartford in company with said Stowe and said Small, and Mr. James E. Ladd?

Ans. I did.

Cross-int. 145. And stop with them at the same hotel in Hartford while you were at Hartford?

Ans. I did.

Cross-int. 146. And did you go on Saturday night, week before last, with said Ladd and said Small, to Bristol, Ct., pass the Sabbath with them, and return with them to Hartford on Monday morning?

Ans. I did not.

Cross-int. 147. Did you remain at Hartford over the Sabbath?

Ans. I did not.

Cross-int. 148. Where did you spend the Sabbath?

Ans. At Milford, Ct.

Cross-int. 149. Have you read or heard read testimony, or any portions thereof, given by said Stowe and by said Small in another case, but about the same upright wheel touching which you have been questioned?

Ans. I have not.

Cross-int. 150. Do you mean so to state deliberately and understandingly?

Ans. I do. I never had anything of the kind in my hand.

Cross-int. 151. I did not ask you whether you had had it in your hand, but whether you had read or heard read this testimony, or any portions of it.

151 Ans. I never heard any of it read. Mr. Mitchell had a paper in his hand at that time, but I can't swear that it was questions and answers, and I can't tell now what it was; all I did see was by looking over his shoulder, and I can't tell now what it was.

Cross-int. 152. Was that paper in print?

Ans. It was.

Cross int. 153. Didn't you hear portions of it read?

Ans. I don't recollect that I did.

Cross-int. 154. Didn't you read portions of it?

Ans. Only a word or two as I looked over his shoulder. I don't think I read a question through, or answer.

Cross int. 155. Have you been at the residence of said Small, at Hartland, within three months?

Ans. I have, once.

Cross-int. 156. When?

Ans. The day we went to Hartford.

Cross-int. 157. Were you there, at said Small's residence, in April or May last?

Ans. I was not.

Cross-int. 158. Where, then, about the time you went to Hartford, did you see, in the hands of said Small or elsewhere, any of said Small's books?

Ans. I did not.

Cross-int. 159. Didn't said Stowe build or make the other wheel for that saw-mill?

Ans. I suppose he did. I suppose that he built both the wheels. I never knew anything to the contrary.

Cross-in. 160. Did the upright wheel drive or operate anything but the saw-mill carriage?

Ans. I don't know as it ever did.

Cross-int. 161. Was there anything in the saw-mill but the carriage that it could drive?

Ans. There was not, to my knowledge.

Cross-int. 162. Please give the names and places of residence of any and all persons who operated or assisted in operating that saw-mill, to the best of your knowledge and information.

Ans. One was Elbridge Dodge. I don't know whether he is in
152 Derby, Vt. He was last fall. Another was Homer E. Reeve. Can't tell you where he lives. The last I heard of him was Wisconsin. I don't know as I saw any other persons running it.

Redirect by Mr. MITCHELL:

Int. 163. In your answer to cross-int 151, you speak of looking over Mr. Mitchell's shoulders when he had a paper in his hand. Please state what, if anything, Mr. Mitchell said to you, when he noticed you so doing?

Ans. Well, he didn't want I should look it over or read any portion of it.

Int. 164. Was that the reason you did not do so?

Ans. It was. He stated that he didn't want I should see any of the testimony, because the other side would question me about it.

Int. 165. Did the request of Mr. Mitchell extend to hearing, also?

Ans. It did.

Int. 166. What was the state of preservation or decay of the upright wheel when it was sold to Luce?

Ans. To all appearances it was sound.

Int. 167. What was the shape of the floats in the wheel at the mill, a few rods from where you lived, referred to in your answer to cross-int. 96?

Ans. I think they were square pieces of board or plank—I should judge about a foot—I don't know but a little more than a foot in length, and from eight inches to a foot wide—somewhere about that.

WILLIAM WEEDEN.

Attest:

J. HENRY HILL,
Examiner.

153 *Deposition of Elbridge K. Dodge.*

Direct examination by C. E. MITCHELL, Esq., of counsel for defendant.

Int. 1. What is your name, age, residence and occupation?

Ans. My name is Elbridge K. Dodge; my age is thirty-eight. I am living in Derby now—Derby Centre, State of Vermont—and I am a mechanic.

(Complainant's counsel interposes an objection to taking the testimony of this witness, because his name is not mentioned in the answer; and because, as he claims, the testimony is not admissible under the answer.)

Int. 2. Where did you reside in the early part of your life, and for how long?

Ans. In the town of Hartland, Vt., till I was twenty-two years old.

Int. 3. State if you ever had knowledge of the building of a saw-mill in said Hartland, known as the Spear & Williams mill.

Ans. I was there through the time of the building of it.

Int. 4. When, if you know, was it built, and by whom?

Ans. In the year '49; built by John L. Stowe, as near as I can remember.

Int. 5. What was your occupation at the time?

Ans. Well, I was living at home then, where I was brought up; went to school that winter; on a farm.

Int. 6. State whether you recollect what wheels were used in the Spear & Williams mill, of which you have spoken.

Ans. I do recollect them.

Int. 7. How many were there?

Ans. There was two.

Int. 8. What were the positions of their shafts?

Ans. One was a horizontal, and one was a perpendicular, if I remember right.

Int. 9. Confining your attention, for the present, to the wheel with the perpendicular shaft, will you please state by what name, if any, it was called, and what circumstances, if any, you have in mind, which make you recollect it, as you have stated?

154 (Question objected to as calling for hearsay and for irrelevant and inadmissible matter.)

Ans. It was called the Stowe wheel. Well, I had a great curiosity; I seen him making that wheel, and I felt a little anxious to learn some kind of a trade, and be a mechanic myself, and I was there more or less, during the time they were building the mill, till it was started. Well, after the mill was started, and two or three years after that, I can't recollect just the time, I helped to saw in the mill. Then, after that a while, the dam washed away; I can't tell whether it was in '56 or '57;

but, according to my best recollection, it was one of those two years. Well, I helped repair the dam up, and start the mill again that fall—the dam and the flume, I should have said. Well, when I come to start the mill I couldn't run the carriage back; there were some sticks in the spout to this upright wheel, which bound so I couldn't start it any way. I had occasion to take it out to see what the trouble was of it. Then I got more of an idea what carried that wheel round, and how the water struck the buckets, as I called them. Putting the wheel back I found no further difficulty with it that time; it was all right. Well, I sawed that fall in the mill—run it—and along the next year a while, fall and spring, when there was water. The last I was running the mill was in '59—the spring of '59; that was the last I had anything to do with it.

Int. 10. What was the first time that you had occasion to examine the wheel as to how it was made?

Ans. It was when Stowe was building of it.

Int. 11. What examination did you then make; that is, when Stowe was building it, and for what purpose?

Ans. Well, I thought those blocks he was cutting out was curious—that he called for buckets was curious. I was very anxious to know what shape he was going to place them in to make a water-wheel. Being a boy then I did not darst to ask him any questions till I see the wheel was finished. Well, then, I was anxious to see it run—what carried it. I used to be there to the mill every chance I could get and see that wheel run. The more I looked at it and examined it, the more I wanted to be a mechanic; thought to myself I could make one myself. I remember another circumstance that makes me remember it more; I staid out of school and got a licking. But this wheel I noticed more in particular than I did the other one.

Int. 12. Who, if anybody, worked with you at the time when you were repairing the flume and dam?

Ans. One man's name was Allen, another Jones Tarbell, and another one was William Weeden.

Int. 13. Do you mean to be understood as saying that you had charge of the running of the mill after this time when it was repaired?

Ans. I did have it. I think there was one fall or spring that Mr. Williams—Mr. Samuel Williams—was at home—I can't say whether it was the fall or spring when he run it—the fall or spring before I went away—the rest of the time I run it.

Int. 14. Can you describe from memory the upright wheel in question, known as you have stated as the Stowe wheel?

Ans. Yes, I can.

Int. 15. Please describe it.

Ans. It was an upright shaft. I should think it was ten feet long. The gear on the top I should think was a foot, as near as I can recollect about it. There was arms mortised through the lower end—six, I think; and there was buckets fastened to those arms; then there was buckets between those arms fastened to what I called a rim. Those buckets was cut out on the back side—the bucket was flatted, I meant to have said—and then the arms rounded off to receive them, according to my best recollection; then they was dug out or scolloped out—I don't know what would be the proper way to call it—and the lower end of the bucket standing in what I called an apron like. There was a band round the lower end of those buckets—two or three inches—from two to two and a half inches—it might have been three-quarters of an inch thick; the rim was on top of the buckets; I should think it was five or six inches thick, as near as I can recollect about it.

Int. 16. What was the diameter of the shaft at the top of the wheel, as near as you can recollect?

Ans. I should think it was eight or nine inches. I couldn't tell exactly; I never measured it.

156 Int. 17. You say the rim was five or six inches thick; in what direction did its thickness measure five or six inches?

Ans. Well, I should have said width; that's what I meant, but I called it thickness at that time.

Int. 18. What was the diameter of the wheel?

Ans. It was called a two foot wheel, I think, as near as I can remember.

Int. 19. Have you any doubt that it was about two feet?

(Question objected to as leading and incompetent.)

Ans. It looked to me as though that was about the bigness of the wheel, as near as I could remember. I never measured it.

Int. 20. What was the distance on the outside of the wheel, from the bottom of the rim down to the top of the band?

Ans. Well, I should think it was eight inches.

Int. 21. Of what materials was the wheel made?

Ans. It was made of wood, of what we called yellow birch, or some call it black birch; it's about the same kind of wood; the same thing.

Int. 22. Was the whole wheel made of wood?

Ans. All with the exception of this iron band round the buckets and what few screws, common wood screws, were bolted into it; or screwed in rather. I think the wheel had an iron step—a piece of wood I called a step. I think the bottom of it was wood, with an iron on it hollowed out where it turned round on.

Int. 23. Which was the farthest forward (by forward I mean the direction in which the wheel moved), the inner edge or the outer edge of each bucket?

Ans. If I understand that question right it would be the outer edge.

Int. 24. Suppose a line drawn from the centre of that wheel through the inner edge of one of the buckets clear to the outer edge of the wheel; how far was it on that outer edge from the outer end of this line forward to the outer edge of the same bucket?

Ans. Well, I should think from the looks it was from three to four inches, as near as I can remember.

157 Int. 25. What was the position of the lower edge of the bucket —I mean the edge of the apron of which you spoke—compared with a line running from the centre of the wheel through the inner edge of the bucket to the outer edge of the wheel?

Ans. It looked to me as though it were on the same line. If I can remember right, that was the way it looked.

Int. 26. How did the water enter the wheel; from what direction?

Ans. I should call it a horizontal direction. I don't know as I could call it any other way.

Int. 27. How did it leave the buckets? In what direction or directions?

Ans. I should call it inwardly and downwardly, as near as I can remember.

Int. 28. I notice you say, "As near as I can remember"; is that because you have any doubt upon the subject?

(Question objected to as leading and improper in form.)

Ans. I can't see as it can have any other way.

(Answer objected to because purporting to be an opinion which can be given only by an approved expert.)

Int. 29. At what age did you cease attending school?

Ans. It was that year. I was one and twenty. I didn't go after I was one and twenty.

Int. 30. Through what was the water conducted to the upright wheel of which you have spoken?

Ans. It was through a spout.

Int. 31. Can you tell which end of this spout was the larger, if either?

Ans. It was the end that went into the flume; that was set into the flume.

Int. 32. Please look at Exhibit No. 7, examine the same carefully, and compare it with the wheel made by John L. Stowe for the Spear & Williams mill which you have described.

(Question objected to so far as it calls for any opinion or comparison such as should come only from an approved expert.)

Ans. It looks to me like the same wheel.

(Adjourned.)

158 AUG. 8, 1875.

Int. 33. How long, to your knowledge, was the wheel which you have described in use in the Spear & Williams mill? I mean from the time when you first saw it there till you last saw it there.

Ans. The last that I had anything to do with the wheel was in '59—in the spring of '59; and after that I went to Grafton, Mass., to learn the machinists' trade; that fall, the last of September, I believe.

Int. 34. Well, how long would that make it?

Ans. It would be nine years.

Int. 35. What kind of a wheel was it in point of usefulness?

Ans. It was a good wheel; a powerful wheel.

Int. 36. Look once more at the model Exhibit No. 7, examining particularly the crown, the band and the floats, noting the fact that in the model the edge of the buckets from which the water discharges itself extends all the way from the under side of the crown downward and outward to the lower edge of the band, and state whether or not, as regards the parts mentioned, the model correctly represents the Stowe wheel which you have described.

(Question objected to as leading, suggestive, purporting to state as facts what is neither proved nor admitted; and as asking for an opinion which it is not competent for this witness to give; and that such comparison cannot properly be made, and that the model is not properly in the case.)

Ans. It does, with one exception; that wheel was larger than this.

Cross-examination by JOHN S. ABBOTT, Esq., of counsel for complainant:

(Complainant's counsel, not waiving objections to the reception of the testimony of this witness, and stating that he shall insist on having it excluded at the hearing, for the reasons given and noted at the commencement of the testimony, propounds cross-interrogatories, each and all provisionally, de bene esse.)

Cross-int. 37. How long have you reside' in Derby?

159 Ans. My father lives there and I make it my home there; this last time I have been there two years, the most of the time.

Cross-int. 38. Doing what, during that time?

Ans. Working on a farm.

Cross-int. 39. And where did you reside next before the commencement of those two years?

Ans. I was out West. I was firing on the Chicago, Alton and St.

Louis Railroad. I was taken sick with the fever and ague, and obliged to come home.

Cross-int. 40. By firing, I suppose you mean that you attended the fires that drove the engine, do you?

Ans. Yes, sir; that was the last that I done.

Cross-int. 41. What else did you do?

Ans. The first of it I went into the wood-house at Road House looking over engines; this was a little town at the junction of two roads.

Cross-int. 42. What two roads and how long were you there?

Ans. It was called the C. & A. Road—it was called on the Jacksonville division. I was there at Road House from the 1st of January to the last of July, I think.

Cross-int. 43. Looking over engines all that time?

Ans. I done extra firing occasionally on the road.

Cross-int. 44. Who employed you?

Ans. The foreman of house; his name was Swan.

Cross-int. 45. Was he the man who employed you?

Ans. Yes, sir.

Cross int. 46. On what road did you do firing during said six months, and during what part of said six months?

Ans. On the C. & A. road. I fired on the Jacksonville branch. I couldn't tell you exactly the days that I was there that six months doing that.

Cross-int. 47. State what part or portion of said six months you were engaged in "firing," as accurately as you can.

Ans. It might have been two months, more or less.

Cross int. 48. While at said Road House what did you do that you call looking over engines?

160 Ans. When a machine comes in from a trip she has to be looked over to see if she is all right—looking close, examining every bolt, every nut and wheel, frame, drivers, eccentrics, links, lifter arms, reverse lever, side rods, netting, see that she has oil and tallow, and waste.

Cross-int. 49. And this was what you did there, was it?

Ans. Yes, sir.

Cross-int. 50. And did you also clean, rub, and burnish the engines, or assist in doing it?

Ans. No, sir; they had other men for that.

Cross-int. 51. What time did you leave home to go west on that occasion, and how long was it from the time you left home till you arrived back at home again?

Ans. It was in September that I started. About two years I was there—not quite—as near as I can remember.

Cross-int. 52. Where were you before you left to go west, say for three years, and what were you doing during that time?

Ans. I was to Springfield, Vt.; worked in a shop perhaps six or eight months, and the rest of the time worked on a farm. Business was dull and I worked at whatever I could find.

Cross-int. 53. In whose shop did you work; for whom; and doing what?

Ans. For Parks & Woolson; in Parks & Woolson's shop, building shears for shearing cloth.

Cross-int. 54. What part of the work did you do?

Ans. The first was forging that I done; the next I worked on the shafts before the shafts were grooved out—and there was knives put in them—were round about once and a half, as near as I can remember.

These knives were backed off to the edge of the steel, and ground for the shear to cut. It was called a shear.

Cross-int. 55. Where were you for three years next preceding the last named three years, and doing what?

Ans. I worked awhile at Rutland, Vt. I was taken sick and went to Derby. I can't state the exact time or days. Then I worked a
161 while at Irasburg, Vt. I think I worked there some seven or eight or nine months. I couldn't say. I think I was to Woodstock some. Couldn't tell how long. I think I went to Springfield then—I won't say for a certainty—as near as I can remember. I worked in a repair shop—job shop at Rutland—or machine shop, doing job work. at Irisbury I worked at custom blacksmithing; at Woodstock I worked in Daniels's machine shop.

Cross-int. 56. When were you at Irisbury as above stated?

Ans. It was either '67 or '68, as near as I can think. I can't say exactly.

Cross-int. 57. When were you at Rutland as above stated?

Ans. I think it was one of those two years. I came from Derby, after I got able to work, to Irisbury.

Cross-int. 58. How long were you at Derby on that occasion? I mean how long during the last named three years?

Ans. I think it was in the fall, and I went away along towards the next spring as near as I can remember.

Cross-int. 59. The fall of what year?

Ans. I think it must be '68.

Cross-int. 60. While at Derby, as named in your last but one answer, were you doing anything? If so, what?

Ans. I was to home with father, helping him on the farm.

Cross-int. 61. Doing what work?

Ans. Well, in the spring when I was there, I helped him make sugar. I don't know that I could tell every little job I done.

Cross-int. 62. During the time mentioned in your fifty-eighth answer were you regularly at work all the time for your father, doing different kinds of work on or about the farm?

Ans. I was not. I worked for the neighbors some. Done some jobs —wood work.

Cross-int. 63. With the exception named in your last answer, were you at work all the time for your father as above inquired?

Ans. He hadn't the work to do.

Cross int. 64. Please give the year, month, and day of your birth.

Ans. I was born the twenty-sixth day of March, 1837.

Cross-int. 65. What time of the year was the building of the saw-mill, referred to in your third answer, commenced?

162 Ans. It was in the fall of the year.

Cross-int. 66. About what time in the fall.

Ans. I couldn't state the day, but I think the mill was raised in November; somewhere about that time.

Cross-int. 67. About how far did your father then live from the mill, and in what direction?

Ans. I think my father worked at Plattsburg, N. Y., at that time. I lived at my aunt's; about a mile northeast from the place.

Cross-int. 68. When did you commence living with that aunt, and how long did you live with her?

Ans. I couldn't remember as to that, for they said I was quite young when my mother died. I was but about two hours old. My grandfather took me first to fetch up. He died, I think, when I was about eight or

nine years old. Then I lived with two aunts and grandmother on a farm, staying there till I was most twenty-two, or in that vicinity.

Cross-int. 69. Was your home on that farm until you were about twenty-two years old?

Ans. It was.

Cross-int. 70. When was it that you "got a licking," named in the last part of your twelfth answer? State the time as accurately as you can.

Ans. It was in the last term of the school—the winter school—three months, for staying to see Stowe build a water wheel, and not attending to my books.

(Last sentence objected to as irresponsive.)

Cross-int. 71. Question repeated.

Ans. It was in '50. Must be in February, I should think.

Cross-int. 72. Were any other boys punished at the same time?

Ans. No, sir; I was all alone.

Cross-int. 73. Who taught that school, and state where he is now living, if you know?

Ans. Sarah Jane Rice. She was living in Hartland the last of my remembrance.

Cross-int. 74. How far and in what direction from the house where your before-named aunt was then living was the school-house in which the school was taught by Miss Rice?

163 Ans. It was called three-quarters of a mile; directly north.

Cross-int. 75. Who lives on that farm now, so far as you know?

Ans. I believe there isn't any one; the last I heard of there wasn't.

Cross-int. 76. Was it at recess when you stayed out, and for which you "got a licking"?

Ans. I went down there at recess when I went out.

Cross-int. 77. Was it down hill from the school house towards the mill?

Ans. It was.

Cross-int. 78. Had you a sled at that time; your own, or belonging to any other person?

Ans. I did not have any.

Cross-int. 79. Did you slide down hill on that occasion?

Ans. No, sir; I walked down.

Cross-int. 80. What time did you get back to school?

Ans. Just before my spelling class's time to spell.

Cross-int. 81. In the forenoon or afternoon was this absence?

Ans. Afternoon.

Cross-int. 82. And about how long was it after you got back to school before the time for the afternoon school to end?

Ans. As near as I can remember, I think it was about half an hour.

Cross-int. 83. When not attending school did you work on the farm while at your aunt's or grandmother's?

Ans. I did.

Cross-int. 84. And all the time while you lived there, till you were about twenty-two years old?

Ans. All except I worked in the saw-mill falls and springs, when there was water; tended there.

Cross-int. 85. What springs and falls did you tend or work in the saw-mill, and for whom?

Ans. It was in '66 or '67; for Spear & Williams; I can't tell which of those two years, '56 or '57; well, I tended from that time, more or less, till I went away, except one spring Williams tended the mill; he was at home.

164 Cross-int. 86. Did any one work with you in the saw-mill? If so, who, and where now living, if you know?

Ans. Homer Reeves was there once in a while, occasionally; he didn't pretend to work much. The last I heard of him he was west; what part I have been unable to ascertain. I don't recollect any other.

Cross-int. 87. State the year and month, as accurately as you can, when you moved from Hartland to Derby.

Ans. It was in '61, I think, the first time I went to Derby; went to father's; September.

Cross-int. 88. State the year and month, as accurately as you can, when you ceased living with your aunt or grandmother at Hartland?

Ans. It was in 1859, the last of September, if I ren ember right.

Cross-int. 89. Where were you between September, 1859, and September, 1861, and doing what?

Ans. From September, 1859, till about January, I was to work at Grafton, Mass.—I believe that's below here—went to learn the machinist trade; I think it was about the first of January. I was taken sick and came to Hartland to my aunt's house. The twenty-seventh day of March I went to Woodstock to work for Daniels & Raymond—machine shop; that next September I went to Derby, to my father's; that would be 1860—no, it was 1861, September, that I went to Derby, because in 1862 I enlisted into the United States service.

Cross-int. 90. For whom did you work at Grafton, as stated in your last answer?

Ans. Williams was the foreman of the shop, and I don't recollect what the company's name was called—a cotton factory's repair shop.

Cross-int. 91. And it was the January next after you went there, when you were taken sick and went to your aunt's house, was it not?

Ans. It was; the next January.

Cross-int. 92. How long were you at Woodstock at work for Daniels & Raymond, as named in your eighty-ninth answer?

165 Ans. Well, I think somewhere about five or six years; nine months I was in the service, and some time around home then; it was most a year before I got round to work again for Daniels.

Cross-int. 93. When you went to your aunt's sick in January, as just now stated, you remained there till the March following, did you not, and then went to Daniels & Raymond's shop in Woodstock?

Ans. I did.

Cross-int. 94. Now, how long did you continue to work at Daniels & Raymond's shop from that time?

Ans. I worked there till I went to the war; I think it was the nineteenth day of August I was warned out, 1862.

Cross int. 95. Do you mean that you worked there continually, right along, without interruption, from the time in March when you say you went there till you went to the war in August, 1862?

Ans. I did, all excepting perhaps a week or ten days.

Cross-int. 96. How long were you in the war?

Ans. Nine months.

Cross-int. 97. Where did you then go, and what did you do?

Ans. Came home to Woodstock; I enlisted from Woodstock; stayed with Daniels the first night; then from there to Hartland to my aunt's; from there to Derby to see father; then late that fall I came back to Daniel & Raymond's to work.

Cross-int. 98. And how long from that time did you continue to work for Daniels & Raymond?

Ans. I worked there till along into the spring.

Cross-int. 99. Where then?

Ans. Then I went to Northfield and worked for the Vermont Central; worked there till the next fall.

Cross-int. 100. Doing what?

Ans. Building new engines.

Cross-int. 101. As master workman, or as a hired mechanic?

Ans. As a hired mechanic.

Cross-int. 102. Where then?

Ans. Daniels sent for me to come back again; I went.

Cross-int. 103. And how long did you then remain at work for Daniels or Daniels & Raymond?

166 Ans. It was along the next winter that I went to Springfield to Parks & Woolson's.

Cross-int. 104. State the length of time, as nearly as you can, that you worked for Daniels & Raymond after you left Northfield and before you went to Springfield.

Ans. I can't tell exactly how long it was. I should think it was somewhere from four to five months, perhaps.

Cross-int. 105. How long did you remain in Springfield?

Ans. I think the first time it was nearly two years as nearly as I can think—can remember of.

Cross-int. 106. And by the first time you mean the time just spoken of when you went from Woodstock, do you not?

Ans. Yes, sir.

Cross int. 107. State the month, as nearly as you can, that you left Springfield at the end of that time that you say was nearly two years.

Ans. I think it was in the middle of the summer some time.

Cross-int. 108. Where then?

Ans. I think I went to Rutland.

Cross-int. 109. And is that the time when you went to Rutland, before spoken of in your testimony? Have you worked in Rutland, or been in Rutland more than once?

Ans. I think that was about the time, but I can't be positive about it. I have been in Rutland at three different times working there.

Cross-int. 110. For whom and how long did you work in Rutland at the time named in your one hundred and eighth answer when you went from Springfield to Rutland?

Ans. Worked for Mansfield & Stimpson—machine shop; it was along into the winter that I left.

Cross-int. 111. When, for whom, for how long a time, and doing what, did you work in Rutland, at each of the other two times named in your one hundred and ninth answer?

Ans. I worked two or three months for the Rutland & Burlington Railroad Company. The next year, I think; I won't be positive about it, worked on locomotive work. Worked for Mansfield &

167 Stimpson—machine shop—worked there quite a while after that; I think some six or eight months.

Cross-int. 112. State as accurately as you can the year or years when you worked the six or eight months last named above.

Ans. It was in 1869 or '70, I should think, as near as I can remember.

Cross-int. 113. State as accurately as you can the year or years when you worked for the Rutland & Burlington Railroad Company for two or three months, as stated in your one hundred and eleventh answer.

Ans. It must have been in '67 or '68; I can't say which.

Cross-int. 114. Did you ever make or assist in making a water-wheel? If so, when where, for whom? and describe the wheel.

Ans. I worked at Daniels's then—Daniels & Raymond I should have said. I helped to fit up two or three wheels of his own make. It was that fall after I came back from the war. They were for himself. It was a wheel in this manner: There were buckets set in slanting and the water striking down upon them through a shoot; and the gate was top of the shoot. I think there was twenty-four buckets in the wheel and twelve shoots as near as I can remember. It was to run his own works; his shop.

Cross-int. 115. Can you give any more full or particular description of this wheel? If so, do it.

Ans. His was a three-foot wheel—one size—and I noticed it was made different from the Stowe wheel that was in that mill, and the water striking those buckets slid right down straight. That's about as near as I can explain it to you—as near as I remember about it.

Cross-int. 116. Were the two or three wheels that you helped to fit up there, as you say, of the same kind, differing only in size?

Ans. They were the same size—two in the machine shop—one in the forge-shop—the same kind.

Cross-int. 117. Which way did the shafts of these wheels stand or were placed?

Ans. Run down through the centre of the wheel.

Cross-int. 118. Give the length and diameter of the shaft.

168 Ans. It run from the wheel through the flume, up through the machine-shop to the line of shafting overhead. I should think from twelve to fifteen feet, as near as I can remember, and from two and a half to three inches in diameter—the shaft.

Cross-int. 119. What was the length and what the width of the buckets? By length I mean from top to bottom in a perpendicular line, and by width the widest place in a horizontal line.

Ans. Well, I never measured them, but I should think from ten to twelve inches from top to bottom. I should think the width would be from seven to eight. I can't tell exactly about it; that's the way it looked.

Cross-int. 120. How did the water leave the buckets in these wheels—in what direction or directions?

Ans. I should call it a downward slant.

Cross-int. 121. A slant which way?

Ans. Under the wheel—width of the buckets of the wheel. That's as near as I can explain it to you.

Cross-int. 122. What were the wheels called—by what name?

Ans. I think there was a man named Russell got up the patents. He and Daniels were building them together—I think they were—I can't say to certainty. Russell, I think, was interested in them some way.

Cross-int. 123. What did you do which you call "helping fit up the wheels"? What did you do touching these wheels?

Ans. I turned the face of the wheel off; help put the shoot on and bolt it, and the gate on top; then help to set one of them in the flume of the forge-shop.

Cross-int. 124. What part do you call the face of the wheel?

Ans. The top of the wheel.

Cross-int. 125. Describe a centre-vent wheel, if you can.

Ans. I don't know as I understand you, unless it is the water leaving from the centre of the wheel.

Cross-int. 126. Is that all of the answer you can give to my request for you to describe a centre-vent wheel?

Ans. I don't see that the water could discharge any other way than downwardly with them, or outwardly.

169 Cross-int. 127. Question repeated.

Ans. I don't know as I can describe it so that you can fully understand it.

Cross-int. 128. Question repeated.

Ans. No, sir.

Cross-int. 129. Then please give such description as fully as you can.

Ans. The water striking the buckets and propelling the wheel round the water, leaving on nearly the whole length of the buckets inwardly from the top down. I think that would be a central-discharge wheel, if I understand the full question right.

Cross-int. 130. Did you ever see such a wheel? If so, when and where?

Ans. I don't know as I can really tell.

Cross-int. 131. Do you mean that you can't tell whether you ever saw such a wheel or not?

Ans. I think I seen a wheel they call central discharge.

Cross-int. 132. When and where, to your best recollection?

Ans. I think there was a wheel in Park & Woolson's shop they called a central-discharge wheel. I never saw the wheel taken up, and I can't say what shape it was.

Cross-int. 133. Did you ever see any wheel in actual operation, which had, to your own personal knowledge, a central discharge? And, if so, when and where?

Ans. I should call that in Spear & Williams's mill a central-discharge wheel, inwardly and downwardly, as it seems to me.

Cross-int. 134. In your one hundred and fifteenth answer you say, "This was a three-foot wheel, one size, and I noticed it was made different from the Stowe wheel that was in that mill." What mill do you mean by the phrase "in that mill"? The mill of Daniels & Raymond, or what mill?

Ans. I meant in the Spear & Williams mill, what I should have said.

Cross-int. 135. Did you ever see a centre-vent wheel? I mean one that you knew to be a centre-vent wheel, unless the one in the Spear & Williams mill was one?

170 Ans. I should call that one, from my best judgment. I never see one but that that I called a centre-vent wheel.

Cross-int. 136. Did you ever hear any one call that a centre-vent wheel?

Ans. I never did, as I recollect about.

Cross-int. 137. Did you ever make or assist in making any water-wheels besides those you have testified about?

Ans. I don't remember of doing any other work on wheels except those.

Cross-int. 138. I infer from your answers that you never read anything about centre-vent wheels. Am I right in this inference?

Ans. I never did.

Cross-int. 139. Do you know what a Jouval wheel is?

Ans. I do not, sir, if I understand.

Cross-int. 140. Can you give the name of any person now living whom you ever heard call the upright wheel in the Spear & Williams mill the Stowe wheel?

Ans. Not that I remember of. I always called it that.

Cross-int. 141. Did you ever hear it called by any other name?

Ans. I never did.

Cross-int. 142. I now shall ask you certain questions in regard to the wheel—the upright wheel—used in the Spear & Williams mill, and I wish every question to be answered as accurately and exactly as you can, without repeating the request in my inquiries. Was the diameter of the shaft the same from top to bottom?

Ans. It looked to me as though it was a little smaller at the top. I couldn't say for certainty.

Cross-int. 143. What length from the top did it look smaller, and how much smaller?

Ans. It looked as though it varied an inch and a half or two inches down to the middle of the wheel, and perhaps farther. I can't say. I don't know the length of it.

Cross-int. 144. Do you mean an inch and a half to two inches in diameter?

Ans. It looked like that, to my best memory.

Cross-int. 145. What was the distance—the shortest distance—from the inside of the rim to the nearest point on the shaft?

171 Ans. I should think about two inches.

Cross-int. 146. You speak of a step on which the shaft ran; on what or in what was that step placed?

Ans. It was for the wheel to set on at the bottom—what I should call it. I believe it was put on to a timber—placed on a timber.

Cross-int. 147. Describe the timber—its size.

Ans. I should think it was from eight to ten inches thick—or square, it would rather be.

Cross-int. 148. Was the top of this step on a level with the upper surface of that timber? If not, what variance was there, and which way?

Ans. I think it was cut into the timber a very little, if I remember right. I think it must have been on a level with it.

Cross-int. 149. How near to the upper surface of that timber was the lower end of the wooden shaft when the wheel was in position to run?

Ans. Well, I should think it was somewhere from six to seven or eight inches—I can't say exactly—it might have been more or less.

Cross-int. 150. Can't you answer the question with more accuracy than that?

Ans. Well, that's the way it looked to me; it might not have been but six—I can't say—I answer to my best memory of it.

Cross-int. 151. Where did that wheel stand when in operation, in relation to the mill?

Ans. It stood about the centre of the mill; a little past the centre towards the north end.

Cross-int. 152. And under the mill?

Ans. It was—the back side.

Cross-int. 153. How far from the flume?

Ans. I should think it was about four feet; it might have been a little more.

Cross int. 154. How far from this wheel, and which way, as to up stream, down stream, or sideways, was the other wheel—the one that drove the saw?

Ans. It was right back of it—up stream.

172 Cross-int. 155. In your answer to the twenty-second interrogatory you say you should call the direction in which the water enters the wheel a horizontal direction; and you add, "I don't know as I

could call it any other way." What do you mean in that answer by the words "a horizontal direction"?

Ans. I mean the water coming in a spout and striking the bucket straight up and down.

Cross-int. 156. Please refer to twenty-fourth interrogatory and answer thereto and state at what point in the centre of the shaft of that wheel, when you gave your answer to the question, you supposed the line named in that question commenced. I mean, what point in the centre of the wheel in relation to the top of the wheel, whether at the top, at the bottom, or at some intermediate point; and if at some intermediate point, describe said point.

Ans. I should call it from the centre of the wheel to the end of the arms—buckets rather—as the position of those buckets stood, would give about that distance to the inner and outer edge of them.

Cross-int. 157. Question repeated.

Ans. If I understand it right, it would be from the top.

Cross-int. 158. Refer now to int. 25, and your answer thereto, and state from what point in the centre of the wheel you supposed (when you answered the interrogatory) the line mentioned in that interrogatory started. At the top or at the bottom of the wheel, or at some intermediate point? And if at some intermediate point, what point?

Ans. I think it must be the bottom.

Cross-int. 159. And in what direction from the centre of the wheel, and at the bottom thereof, did you understand (when you gave your answer to the twenty-fifth) that line was supposed to be drawn?

Ans. I understood it to find those distances between the buckets.

Cross-int. 160. Question repeated.

(Question objected to, the witness having answered the same.)

Ans. From the centre to the outer edge of the wheel, I should call it, as near as I understand it.

Cross-int. 161. Upon a horizontal plane?

Ans. Well, I should call it on a horizontal line.

173 Cross-int. 162. It, the line, would then strike or coincide with the lower end of the band at the outer side of the wheel, would it not?

Ans. I don't know but 'twould; as well as I can explain it. I can't explain it so you can understand it.

Cross-int. 163. Don't you know whether it would or would not?

Ans. I rather think it would.

Cross-int. 164. Now, suppose such a line drawn in a horizontal direction from the centre of the wheel to the lower edge of the band, right at the point where the lower edge of the band and the lower edge of the bucket come together; and then if you were to measure from that point towards the centre of the wheel on that horizontal line just so far as that horizontal line and the lower edge of the bucket coincide or come together, what distance would you get?

Ans. Well, I should think it would be about eight inches, if I understand it.

Cross-int. 165. And you do understand the question, don't you?

Ans. I think I do.

Cross-int. 166. How large was the spout at the flume end?

Ans. Well, I should think it was twelve inches square—it might have been a little more—it was all of that, I think.

Cross-int. 167. And how large at the other end?

Ans. It was just as big as between the buckets, and as high.

Cross-int. 168. Well, give the dimensions, as near as you can.

Ans. Well, I should think it was eight inches high, and from three to four inches wide, as near as I can remember how it looked.

Cross-int. 169. And you mean at the upper end it was twelve inches high and twelve inches wide, do you?

Ans. I do; more or less.

Cross-int. 170. At which end was the gate?

Ans. It was in the flume end—the upper end of the spout.

Cross-int. 171. Where were the sticks which you spoke of in the latter part of your ninth answer? In which end of the spout?

Ans. They were in the lower end, next the wheel, on the buckets.

174 Cross-int. 172. Did any one assist you in getting them out; and if so, who?

Ans. No one.

Cross-int. 173. How far did you move the wheel at that time?

Ans. I should think about a foot; it might have been a little more.

Cross-int. 174. In what way did you move it?

Ans. I raised it up a little and then slipped it out a little towards me, and took out the sticks.

Cross-int. 175. Raised it up how—by what means?

Ans. I put a chain around it first, I think, and then took a mill bar and pryed on it; got it up where I wanted it, blocked it, and slipped it back.

Cross-int. 176. Did you ever examine the wheel when it was running?

Ans. I did, sir.

Cross-int. 177. How near to the water was the bottom edge of the band when the wheel was running?

Ans. Well, I couldn't tell exactly, as the water was all over it.

Cross-int. 178. All over what? What do you mean by the word "it"?

Ans. Well, it made the water fly so I couldn't tell.

Cross-int. 179. And of course you couldn't see under the wheel when it was running, could you?

Ans. I could when it was first started; by that I mean when we first hoisted the gate.

Cross-int. 180. And when it was just moving slowly, I suppose?

Ans. Yes, sir.

Cross-int. 181. How many times a minute did that wheel revolve when in full speed, according to your best knowledge and judgment?

Ans. At that time I could not tell you, as I was not used to seeing wheels run; afterwards, being in other shops and seeing other wheels run, I thought that wheel was a very powerful wheel and run very rapidly; I should think fifty or sixty times a minute, as near as I could judge by it.

Cross-int. 182. Where did Mr. Napoleon B. Luce live when you last knew or had information of him; and when was that?

175 Ans. It was in Hartland when I lived at home; that I called my home then with my aunts and grandmother.

Cross-int. 183. When did you leave Vermont to come to this place?

Ans. In 1859, the last of September, if I recollect rightly the time.

Cross-int. 184. I mean when did you last leave Vermont?

Ans. Last Friday.

Cross-int. 185. And where have you been since?

Ans. I have been at Bristol, Ct., at the hotel.

Cross-int. 186. When and for how long time were you in Bristol?

Ans. I arrived there Saturday night and left Monday night.

Cross-int. 187. And did you see any water-wheels or models of water-wheels at Bristol?

Ans. I did.

Cross-int. 188. And Mr. Ladd showed you some, did he not—Mr. James E. Ladd?

Ans. He did.

Cross-int. 189. And talked with you about this case, did he not?

Ans. He did, some.

Cross-int. 190. And he stated to you what said Stowe and Mr. Small and said Weeden had testified in this case, or portions of what he represented they or some of them had testified, did he not?

Ans. All the testimony I heard was Mr. Stowe's, what I heard yesterday; nothing was said of Mr. Small or Mr. Weeden, that I heard of.

Cross-int. 191. Didn't you know before yesterday that said Stowe had given testimony touching that upright wheel that was used in the Spear & Williams saw-mill?

Ans. I didn't know till Mr. Ladd came to my place and I described the wheel out to him; asked me if I remembered such a wheel in Spear & Williams's mill, and I told him I did; he told me that Mr. Stowe had been there, and Mr. Weeden and Mr. Small, and that was all that was said; I described the wheel to him before he told me anything about this case.

176 (Answer objected to as irresponsive.)

Cross-int. 192. Question repeated; and witness is requested to answer what I claim I ask, and not to run away from the question and answer what I do not ask.

(Counsel for respondent submits that the witness answered the question.)

Ans. All I know is what I heard Mr. Stowe say, and Mr. Ladd, that he had been here once.

Cross-int. 193. Did you have conversation with said Stowe about this wheel at any time this summer, and before yesterday?

Ans. No, sir; I have not seen Mr. Stowe for several years until I met him coming up here yesterday morning, at the corner.

Cross-int. 194. How much time in all, according to your best recollection and judgment, has been spent in conversation between you and said Ladd, in relation to this case, and touching that said upright water-wheel, and upon the subject of water-wheels, all put together?

Ans. I should think at home we talked from half to three-quarters of an hour about it, from the time we started, and there hasn't been half an hour since, that I can remember of. When I was at his place I was round the town most of the time, looking it over.

Cross-int. 195. When at Vermont did he show you a little model of a wheel?

Ans. He had one there that he showed to father, but I didn't examine it or pay any attention to it, for I was getting ready.

Cross-int. 196. What time on Friday did you leave home?

Ans. I think it was between eleven and twelve, if I remember right; it was not far from noon, any way.

Cross int. 197. Did you go to New Britain before going to Bristol?

Ans. He stopped at New Britain to see Mr. Mitchell, but Mr. Mitchell was going away on the next train, or that same train; I know we were not there more than five or ten minutes.

Cross-int. 198. Were you in this room yesterday during the time said Stowe was giving testimony in this case?

Ans. I was.

Cross-int. 199. And you sat by his side on the same settee, or sofa, while he was testifying, did you not?

177 Ans. I did.

Cross-int. 200. And while he was examining model Exhibit No. 7?

Ans. I was.

Redirect examination by Mr. MITCHELL:

Int. 201. You say in answer to cross-int. 155, that you mean by the words "horizontal direction, the water coming in a spout and striking the buckets straight up and down." Would you please explain a little and tell just how the water got into that wheel?

Ans. Well, the spout coming from the flume to the wheel being under such head and force, striking those buckets inwardly and downwardly, as near as I can express it, it drove that wheel with great force.

Int. 202. Did the water strike the wheel from the side, or from the top, in entering it?

Ans. I should call it from the top, downward—followed downward, as near as I can explain it.

Int. 203. I don't allude to the general direction from the flume to the wheel, but from the spout into the buckets; with this explanation, please answer the question.

Ans. It struck the inside, the top of the buckets, as it looked to me.

Int. 204. Between what two portions of the wheel did it enter the buckets and strike the top?

Ans. Between the buckets.

Int. 205. What other two portions?

Ans. There was no other place for the water to strike, that I could see.

Int. 206. Well, in striking the buckets, on entering the wheel, between what parts of the wheel, besides the buckets or floats, did it pass?

Ans. Between the rim and the band, I should call it.

Int. 207. You say that the upper end of the shaft looked smaller than the lower; was there a gradual taper between the larger diameter and the smaller, or how was it?

Ans. I should think it was from the centre, as near as I can remember, as it looked, though I never measured it.

178 Int. 208. In answering cross-int. 164, you say, "Well, I should say it would be about eight inches, if I understand it"; as you understood the question, what was it that you thought would be about eight inches?

Ans. Well, I understood it was from the end of the bucket to the shaft.

Int. 209. Suppose you had understood the question to be "How far did the bottom of the bucket extend inward in a horizontal line from the bottom of the band, before it began to bend upward?" what would your answer have been?

(Question objected to as suggestive, and as implying what is not proved or admitted.

Counsel for respondent claims that the question implies nothing but what has been proved.)

Ans. I should call it about two inches.

Int. 210. Did Mr. Ladd have with him at Derby any of the models used in this case; or, so far as you know, any similar models?

(Question objected to as improper on the redirect.)

Ans. He did not.

Int. 211. State whether you ever saw any of the models used in this case before you saw them at Worcester, yesterday.

Ans. I never did.

ELBRIDGE K. DODGE.

Attest:

J. HENRY HILL,
Examiner.

179 EVIDENCE FOR DEFENDANT.

Taken pursuant to the sixty-seventh rule of the Supreme Court of the United States, in equity, as amended, before me—

N. AUSTIN PARKS,
Special Examiner.

BOSTON, *Sept.* 7, 1875.

Present: Jno. S. Abbott, esq., of counsel for complainant; Causten Browne, esq., E. C. Mitchell, esq., of counsel for defendant.

Deposition of Henry B. Renwick.

Direct examination by CAUSTEN BROWNE, Esq.:

Int. 1. State your name, age, residence and profession.

Ans. Henry B. Renwick; fifty-eight years of age. I reside in the city of New York, and am by profession a civil and mechanical engineer, and principally occupied at present in the examination of machinery and patents; and I am frequently examined as expert in suits in which patents are in question.

Int. 2. Have you examined a copy of the original patent, granted May 15, 1860, to A. M. Swain, for improvement in water wheels, the specification of which is printed as Exhibit A, at page fifteen of the record of this case; and also a copy of the reissue of such patent, dated Nov. 19, 1872, printed as Exhibit B, on page nineteen of the record; and do you understand the construction and operation of the machinery described in the original and reissue, respectively?

Ans. I have examined official copies of both the original and reissue referred to, and believe I understand the construction and operation of this machinery, described in the original and in the reissue.

Int. 3. Comparing the original patent with the reissue, will you state what, if any, substantial difference you find in construction and
180 operation of the machinery described in the two specifications, respectively, and explain why you regard such difference as substantial, prefacing your answer by such brief explanations as you deem desirable of the character and general operation of the apparatus to which these specifications relate?

(Question objected to; first, as leading and suggestive; second, because the court is to determine from examination and comparison of patent and reissue and their drawings; third, because the witness has not been shown to be an expert competent to answer the inquiry.)

Ans. Both the patent and the reissue describe a turbine or reaction water wheel, with its case, chutes to direct the water to the wheel, and gates to vary the flow of water upon the wheel. They both describe wheels having a crown, as it is called in the reissue, and a rim, as it is called in one place in the patent, to which the upper edges of the buckets are attached, and a band or ring, uniting the lower outer edges of all the buckets. In both the patent and reissue the discharge

edges of the buckets extend from the crown to the band, and in both the edges of the buckets are on a gradual curve in a vertical plane, the bucket fining away to nothing, or almost nothing at the band, as may be seen by referring to the buckets, as shown in Fig. 1, both of the original and the reissue. The crown of the wheel in both the original and the reissue is not horizontal on its lower side, but extends downward, as it progresses inward towards the centre of thewheel, and verges into a large hub, which surrounds the shaft and occupies a considerable portion of the space within the centre of the wheel. The drawings of the reissue and original, judging by the eye, differ from each other in the form and proportion of the crown and hub with reference to the other parts of the wheel. In the reissue the crown is not so much bent downward as it is in the original patent, and the hub is smaller in proportion, and there would therefore be less obstruction to the discharge of water from the bucket and a more full descent of that water, after it had been discharged, than in a wheel made in exact accordance with the drawings of the original. Further, in a wheel made in accordance with the drawings of the reissue, owing to this difference in shape of the crown and hub, some of the water discharged would be dis-
181 charged in planes more nearly horizontal than it could be discharged from a wheel made in accordance with the drawings of the original patent; but even in the reissue the discharge from the upper parts of the buckets, speaking with regard to its horizontality, would not be horizontal, nor even approaching the horizontal, but in curved lines determined by the shape of the lower part of the crown and the shape of the hub, which lies inside of the wheel and inside of the inner edges of the buckets.

Prior to the date of Swain's original patent, to my knowledge, two different kinds of turbines were well known to engineers, viz, the centre discharge turbine, in which the water was discharged in planes perpendicular to the axis of the wheel, known as a variety of the Fourneyson turbine, and in which the capacity of discharge of water from the wheel was the capacity of the cylinder contained within the inner edges of the buckets, minus the shaft; Exhibit G represents such a wheel; the other turbine was known as the Jouval or downward discharge turbine, in which the water was discharged downward into an annular space, bounded by two cylinders, one enclosing the outside of the wheel, and the other being a prolongation of the inner periphery of the wheel. Now the turbine wheel described in the original patent to Swain does not discharge the water in either of these ways; but, owing to the shape of the float, and the shape of the crown and hub, discharges the water in diagonal curved lines leading inwards and downwards; and that it does so, and was intended to do so, appears from the description and drawings of the crown and hub, and the description of the buckets, and from the description of the mode of operation in the patent, which is as follows: "The water strikes the floats with all the force and velocity due to its head directly under the rim of the wheel, which is so curved as to force the water down rapidly on the lower curved parts or bottoms of the floats." And also, "The water is discharged down between the curb and wheel, and lower curb, H." If there had been any intention of discharging the water in nearly horizontal lines, the lower side of the rim or crown would not have been bent downwards so as to force the water down, and the space in the centre of the wheel, into which horizontally flowing water would escape, and which would be necessary for its escape, would not have been stopped up by the hub,
182 and the downward prolongation of the crown after it extends

inwards beyond the inner edges of the buckets. And, if it had been intended that any considerable portion of the discharge should have been downwards, as in the Jouval wheel, then the delivery edges of the buckets would not have been curved, as I have before described, but would have been formed, as they might be formed, by taking one of the buckets out of Exhibit G and placing it on top of one of the buckets of Exhibit H, the dome of Exhibit H being cut away so as to allow of a discharge from the buckets of G, placed on top of the buckets of H.

In the reissue patent, in addition to the difference in the drawings before referred to, there are differences in the description; which differences are substantial and material. The description of the construction of the floats found in the old patent, and also the description of the flow of the water arising from the construction of the floats, crown and hub, are left out in the reissue, and in place of them a description is put in, which is in substance a description of the operation of the floats of the well known Leffel wheel, which is, in fact, a combination in one wheel of a Fourneyson and a Jouval turbine. In the reissue, it is stated that "the upper horizontal edge of the floats is attached to the crown of the wheel." Now, there is no horizontal upper edge to the float in the original patent, either described or represented in the drawing; on the contrary, the upper edge of the float, when projected upon a vertical plane, is not horizontal, but curving downwards, as it extends inwards, in conformity with the shape of the crown. This description of the reissue describes the upper part of the float, or bucket, like those shown in Exhibit G, and does not describe that shown in the original patent.

The only further description of the floats in the reissue is that they may (not are or must) be curved in a horizontal direction at their upper portion, and have a curve of double curvature at their lower portion. This description is vague, indefinite, and would apply to a multitude of forms of buckets. By this construction, whatever it may be, the reissue goes on to state that an inward flow turbine and a downward flow turbine are combined effectively in one wheel, having a discharge line equal to the height of the float in the Fourneyson wheel, and also that due to the width of the float in a radial
183 direction, as in the Jouval wheel. As I have before stated, the wheel of the original patent discharges neither like the Fourneyson nor the Jouval, and I consider this statement, that buckets may be formed so as to discharge in those two ways, as an entire departure from the invention described in the original patent. Further, even the wheel shown in the drawings of the reissue, altered in form and proportion, as it is, from the original, would not discharge in the manner described in the reissue; the fact that it would not so discharge being proved by the shape of the edges of the buckets, as shown in the drawing, by the shape of the under side of the crown, and by the presence of a part of the crown and the hub in the centre of the wheel; this obstruction in the centre of the wheel filling up the space which is absolutely necessary for the horizontal discharge of the water in a centre discharge Fourneyson turbine. If the wheel had been formed in order to combine an inward flow turbine and a downward flow turbine effectively in one wheel, the crown of the wheel would have been horizontal on its under side, or nearly so; that part of the crown within the inner edges of the bucket and the hub would have been dispensed with, so as to permit free escape of water towards the centre of the wheel and without downward deflection, and the shape of the discharge edges of the buckets would

have been altered in the manner before pointed out, and, if the engineer had known how to produce the best effect, the lower inner edges of those buckets of altered shape would have been closed up by a solid ring, so as to force a portion of the water directly downward in the manner in which it is so forced by the solid ring which shuts up the inner edges of the buckets in Exhibit H.

(Complainant's counsel claims that a large part of the foregoing answer is irresponsive, speculative, argumentative and contains matters not embraced or referred to in the question, and for these reasons he objects to all such portions of the answer.

Defendant here puts in evidence, to be marked Exhibit No. 10, a certified copy of the specification and drawings of U. S. letters patent granted to Abel Greenleaf, May 16, 1854, No. 10,916, for improvement in gravity and percussion water power machines; also puts in evidence,

to be marked Exhibit No. 11, a certified copy of the specification

184 and drawing of U. S. letters patent granted to Waldo Whitney, May 10, 1864, No. 42,708, for improvement in water wheels, being the specification and drawings referred to in the paragraph beginning, "It is further agreed," of the stipulation printed in this case at page 14 of the complainant's record; and also puts in evidence, to be marked Exhibit No. 12, a certified copy of the specification and drawing of U. S. letters patent granted to Jno. Temple, assignor to Temple, Mills & Stout, dated February 8, 1859, No. 22,902, for improvements in water wheels; also puts in evidence, to be marked Exhibit No. 13, a certified copy of the Patent Office model, making part of the record of the said patent of John Temple.

Plaintiff's counsel objects to the admissibility of Exhibit No. 10, because not referred to in the answer, and not receivable under the said stipulation; and also objects to the admissibility of Exhibit No. 13, as not receivable under the answer.

Counsel for defendant, to avoid misunderstanding in regard to the introduction of the Whitney patent, Exhibit No. 10, here states, for the benefit of counsel for complainant, that such patent is introduced in order that the admission made by the complainant on page 14, to the effect that the contrivance described in that patent dated back to August 1, 1856, may be of some value to the defendant, and that it cannot be of any value unless the court is put in possession of evidence as to what the contrivance described in that patent is.)

Int. 4. Have you examined the specification and drawings of the Greenleaf, Whitney and Temple patents, just put in evidence, and do you understand the construction and operation of the apparatus shown and described in them, respectively?

Ans. I have examined all of them and understand fully the construction and operation of the apparatus shown and described in the Whitney and Temple patents; and understand the construction described in the Greenleaf patent, with the exception of the supplementary floats, H, H. I cannot find out from the drawings and description exactly how these supplementary floats are constructed.

Int. 5. Will you look at the model now shown you, marked Exhibit No. 14, and say, if you know, what it represents?

(Int. objected to for the same reasons as No. 3, and Exhibit No. 14 objected to as inadmissible.)

185 Ans. I have examined the model several times, and have compared it with the description and drawings of the patent to Whitney of May 10, 1864, and the model is a substantially correct represen-

tation of the wheel described and represented in the drawings of that patent.

Int. 6. Will you now compare, separately, the structures described and represented in the Greenleaf, Whitney and Temple patents, respectively, with the structure described and represented in the original patent of Swain (including in your comparison, if you find it material to do so, Exhibit E, which is said by the complainant to be a representation of the original Swain Patent Office model), and state how far, if at all, you find in either of the three first named patents the structure described and shown in the Swain original patent, and also how far, if at all, you find in either the structure exhibited in defendant's wheel Exhibit D.?

(Objected to for the same reasons as No. 3; and the last clause of the interrogatory relating to Exhibit D is objected to as incompetent and inadmissible.)

Ans. The wheel described in the patent to Waldo Whitney, Exhibit No. 14, is identical with the wheel described in the original patent to Swain, in so far as the crown or rim, the buckets, and the band which unites the outer edges of the buckets at their lower parts, are concerned. It is also identical with the Swain wheel in its mode of operation, resulting from the construction of the crown, buckets and band. It differs from the Swain wheel somewhat in proportion, in the fact that the band is broader and that the crown descends more rapidly as it goes inward; and it is wanting in that part of the crown and hub which, in the Swain wheel, lies inside the inner edges of the bucket and chokes up the space for the discharge. This wheel differs from the defendant's wheel Exhibit D (which I examined this morning at the United States court-house), in the fact that the defendant's wheel has the under side of the crown nearly horizontal, and the buckets prolonged upward to that horizontal plane, in such way that the defendant's wheel has an effective horizontal discharge from the upper parts of the bucket; which effective horizontal discharge is not found in the operation either of the Whitney wheel or the wheel of the original Swain patent. The
186 defendant's wheel also differs from both the Whitney and the original Swain in the shape of the buckets. In the Swain wheel original patent, they are described as parabolic on their acting faces, and are so represented in the drawings; whereas, on the contrary, in defendant's wheel the acting faces of the buckets, through the greater part of their length, are of a cym reversâ curve, supposing the buckets to be cut by a horizontal plane; the lower part of the buckets are further shaped in defendant's wheel so as to give an effective downward or Jouval discharge to a small portion of the water, owing to the fact that the buckets in defendant's wheel do not, at their lower edges, fine away to nothing at the band, as they do in the Whitney wheel and the wheel of the original Swain patent. The wheel described in the patent granted to Temple, Mills & Stout I have been familiar with for several years; I refer to Exhibit 12. It is substantially identical with the wheel of the Swain original patent, and with the Whitney wheel, except in the curve of the buckets, as cut by a horizontal plane or a plane perpendicular to the axis of the wheel, and in the shape of the lower part of the buckets. The original Swain patent describes the buckets as of parabolic form. In the Temple wheel they are of a cyma reversâ curve on their acting faces, and at the bottom they do not fine away to nothing at the band, and do not have their inner edges in a regular curve extending from crown to band, as in Swain and Whitney; but, on the contrary, are so shaped as to give a small amount of effective downward

or Jouval discharge, in addition to the oblique downward and inward discharge of the greater part of the water. But this wheel, like the Swain original and the Whitney wheel, has a crown extending downwards and inwards, has a band to which the outer lower edges of the floats are attached, and also floats having their discharge line extending from the crown at their inner edge to their lower outer edge, where they are connected to the band. This wheel differs from the defendant's wheel in the fact that it has a crown extending downwards and inwards, whereas that of the defendant is substantially horizontal, thus admitting, in the defendant's, of a considerable amount of horizontal discharge; but the buckets of this Temple wheel, except in the fact that they do not extend upwards to a horizontal under face of the crown
187 are substantially like the buckets of the defendant's wheel, which are of a cyma reversâ curve in horizontal planes. That the shape of the buckets is such in the Temple wheel appears plainly from the description and from the model Exhibit No. 13.

Turbine wheels are sometimes set upon horizontal shafts, and the Swain wheel and the defendant's wheel might be so used; and I have been informed that the Whitney wheel has been so used. When so used, the buckets, crown and bands act in the same way as when set upon vertical shafts. The patent granted to Greenleaf describes a turbine wheel set upon a horizontal shaft. It, in fact, describes two of these wheels, set crown to crown, the water from one escaping to the right and from the other to the left of the case. Each of these wheels has a crown extending inward, and towards the pivots of the shaft as it goes inwards, so that it is substantially of the same shape as the crown of the original Swain, the Whitney, and the Temple wheel. It also has a band substantially the same as the bands on those wheels and performing the same duty as they do; and it further has buckets extending from the crown to the band, and with a discharge orifice extending from the crown to the band; the buckets being so shaped as to give an oblique discharge, like that of the Swain and Whitney wheel. As far as I can discover, however, the upper part of the buckets does not extend over the conical surface of the crown, as it does in Whitney, Temple and Swain; and, in that respect, it differs from those wheels. It differs from the defendant's wheel because it has a different shape of buckets (a shape very like that of Whitney and Swain), and because it does not have a horizontal under surface of the crown; or, in other words, a surface in a plane perpendicular to the axis of the shaft, or nearly so.

(All portions of the above answer which are speculative, or irresponsive, or hearsay, are objected to.)

Int. 7. For the purposes of the mode of operation resulting from the combination of the crown, buckets and band, as described and shown in the original Swain patent, do you regard the differences of construction which you have pointed out, between the wheel in the Whitney patent and the wheel in the original Swain patent, as substantial, or as merely formal?

(Objected to as to No. 3.)

188 Ans. As merely formal.

Int. 8. The fifth claim of the complainant's reissue is in these words: "A water wheel having an effective inward flow and discharge of part of the water, and an effective downward flow and discharge of part of the water, simultaneously, in one wheel, whereby the effective area of discharge is increased without increasing the diameter of the wheel." Assuming this claim to be not for a function of a water wheel,

but for a certain mechanical construction of a water wheel by which that function is performed, will you state what is the mechanical construction, described in the preceding parts of the specification, which is necessary to the performance of the function referred to?

(Objected to as to No. 3.)

Ans. There is no mechanical construction described in the specification, or represented in the drawing, which will perform the function referred to, unless the words, commencing "by this construction and arrangement," are held to be a description of the manner of constructing a wheel. I do not consider them as such a description; and the drawings clearly represent a wheel which will not perform those functions, and represent buckets which do not have "a curve of double curvature at their lower portion,"—which is the description given of them in the patents.

(Answer objected to as irresponsive and inapplicable to any issue or defence set up in the answer, and as speculative.)

Int. 9. Will you state what difference, if any, you find between the parts which are referred to in the first claim, and the parts which are referred to in the second claim, and the parts which are referred to in the third claim of this reissue, and the mode of combination of those parts?

(Same objection as to third interrogatory.)

Ans. I have examined the three claims referred to in the question several times, and believe that the parts referred to in all three are the same, and combined in the same way; these parts being the crown, the floats or buckets, and the band. The first claim is a claim to "a water wheel, the floats of which have a discharge line extending from the crown at their inner edge to the lower outer edge of the wheel."

189 In order to find the elements of this claim I must have a water wheel—a complete structure—with float, extending from the crown to the lower outer edge of the wheel. The wheel must, therefore, have a crown, from which the floats can extend, and a lower outer edge, which is the band to which the floats extend; and I therefore find in this claim the combination of the crown, the floats and the band in such manner that the floats shall have a discharge line extending from the crown to the band.

It is perfectly evident the second claim is a claim to the combination of these same three parts, and that the third one must also include the band, as it states that the discharge line extends from the crown to the lower outer edge. Now the only lower outer edge is the lower outer edge of the band. In my opinion, all three of the claims are, in reality, to the same combination of the same parts.

(Answer objected to as assuming to give a construction to the patent, which is the province of the court.)

Int. 10. Please examine defendant's Exhibit No. 7, and compare the same with the Swain original patent and with defendant's wheel Exhibit D.

(Objected to as to ints. 3 and 6.)

Ans. If this wheel, Exhibit 7, had a crown extending downwards and inwards to the hub, instead of a crown with a horizontal under surface, and not extending to the hub, it would be substantially identical with the Swain wheel in all respects, and would operate in the same manner. Owing to the fact that it has a crown of this character, the buckets would have an effective inward discharge were not that discharge choked by the shaft or hub, and the spokes or wings, which attach the wheel to the shaft and choke the inward discharge. This wheel

like the defendant's, has a crown with a lower horizontal surface, has buckets, and had a rim or band; and the buckets have a discharge line extending from the crown to the band; but the buckets in this wheel are shaped substantially as Swain's, and not like the defendant's; and in this wheel the centre discharge is choked, which is not the case in the defendant's wheel.

(Answer objected to as speculative and not responsive.)

Adjourned.

190 SEPT. 8, 1875.

Int. 11. Will you now state whether you find the structure Exhibit D (being the alleged infringing wheel of the defendant) to embody the construction and arrangement of parts recited or referred to in either of the claims of the reissue patent in suit, and which, if either, giving your reasons for your opinion?

(Objected to on the same grounds as ints. 3 and 6.)

Ans. That will depend upon the question how the claims are construed by the court. If the court should construe the first three claims to be to a combination of a crown and floats and band, or one of the claims to a combination of the crown and floats alone in all cases irrespective of the form of the crown and of the floats, and the parts being so combined that the upper parts of the floats shall be attached to and supported by the crown, and the lower outer edges of the floats be attached to and supported by the band, then the defendant's wheel would embody the construction and arrangement of parts referred to in the first three claims; but if, on the contrary, the court should construe these claims to be for the combination of these parts when the crown descends, as it extends inwards, so as to force the water downwards rapidly on the bottoms of the floats, and when the buckets are of the paraboloidal shape, described in the original patent, the two being combined in such manner as to discharge the water diagonally, as before described by me, then, under such a construction of the first three claims the defendant's wheel would not embody the construction referred to therein. With regard to the fourth, sixth, seventh, eighth, ninth, tenth and eleventh claims, I would state that it is evident that the defendant's wheel does not contain the constructions referred to therein. I have already said that I cannot find, even in the reissue, a description of the mode of constructing buckets so as to produce a wheel having simultaneously an effective inward and an effective downward flow, thus increasing the area of discharge without increasing the diameter of the wheel. If the court should construe this claim to cover a wheel of any shape of bucket which would produce the effects recited in the
191, 192 claim when the space within the wheel was not choked up, then the defendant's wheel would embody the construction referred to in that claim; but if, on the contrary, the court should construe that claim to cover a wheel made with buckets substantially such as are described in the original patent and shown in the drawings of both the original and reissue, and operating to discharge water as buckets of that shape would operate, then the defendant's wheel would not embody the construction referred to in the fifth claim of the reissue.

(Same objection to this answer as that to answer to int. 3.)

Int. 12. There is a possible obscurity, which we are required to put an interrogatory in order to have removed, in this part of your last answer: "Or one of the claims to a combination of the crown and floats alone in all cases, irrespective of the form of the crown and of the floats."

It may possibly be doubted what the word "irrespective" is intended to qualify. Will you please explain?

Ans. I supposed that the court might construe the three first claims in such a way that each of them included crown, band and float, or that it possibly might construe the first claim to include either crown and float, and the third claim to include only the crown and float. Now, I supposed, in the first part of the answer, that whether the claims were construed to include all or only part of these elements, the court might consider each element irrespective of its substantial form; and the word "irrespective" is intended to apply to the form of the float or the form of the crown, as elements of the first three claims, whether those claims be considered as embodying two elements or three elements in combination.

(Complainant's counsel declines to cross-examine.)

HENRY B. RENWICK.

Attest:

N. AUSTIN PARKS,
Special Examiner.

193 SWAIN TURBINE AND MANUFACTURING Company
v
JAMES E. LADD.

EVIDENCE FOR COMPLAINANT IN REPLY.

Taken pursuant to the sixty-seventh rule of the Supreme Court of the United States, in equity, as amended, before me.

JOHN G. STETSON,
Examiner.

Deposition of Asa M. Swain.

Direct examination by JOHN S. ABBOTT, Esq., of counsel for complainant.

LOWELL, MASS., *Oct.* 21, 1875.

Int. 1. Please state your name, age, residence, and occupation.

Ans. Asa M. Swain; forty-five; North Chelmsford, Massachusetts; machinist.

Int. 2. Are you the patentee named in letters patent of the United States, No. 28,314, and dated May 15, 1860?

Ans. I am.

Int. 3. When and where did you first give any attention, practically, to mechanics or mechanical pursuits?

Ans. In Sanbornton, N. H., in the fall of 1844.

Int. 4. What did you do at that time and place? With whom, if any one, were you employed, and for how long a time?

Ans. I went to serve an apprenticeship at sash, blind, and door making, and house carpentering, with Warren Wadleigh. I remained with him about three years.

Int. 5. What was your next occupation; where, and with whom, and how long?

Ans. Most of the time, until the fall of 1853, worked for different individuals at the same work—house carpenter work. One season, the spring of 1852, worked a saw-mill on shares.

Int. 6. When did you first have anything to do with the construction, or the putting in operation, or assisting in repairing a water-wheel?

194 Ans. During my apprenticeship; cannot give the date.

Int. 7. Can you state the year?

Ans. No, sir; I have no doubt it was every year during that apprenticeship,

Int. 8. When did your apprenticeship end?

Ans. In the spring of 1847.

Int. 9. Please now state pretty fully, and as accurately as you can, what you did, and when, and for whom, in relation to water-wheels, from the end of your apprenticeship until you commenced working upon the device described in said letters patent, proceeding as nearly as you can in the order of time.

Ans. I recollect of rebuilding portions of the saw-mill wheel in the spring of 1852, also, about that time, of going with one H. K. Thompson to advise with him in regard to buying the wheel. I went to examine the wheel with him and give my opinion in regard to its merits. I examined other wheels of this same description and measured the distance water would spirt out through the joints of the scroll. From 1852 to 1853 I worked for J. H. Combs, and often examined the wheels in his mill and assisted in repairing them. In November, 1853, I came to Lowell for the Massachusetts Cotton Mills Company, Henry Gotham, foreman; it was then I first became acquainted with the Fourneyron turbine. I remained there—having occasion to assist in cleaning and repairing and adjusting turbines and other water wheels--until August, 1854. I then went to the Lowell machine shop and engaged myself at an opportunity to work at pattern-making and drawing, with an opportunity of studying the principles and details of turbines. I remained there until some time in January, 1855; business being very dull I removed to Sanbornton again. During this time the thought occurred to me that a central discharge wheel with guides somewhat in reverse of the Fourneyron might be made in an economical and cheap manner, also very efficient, to supply the place of the central discharge scroll wheels, with which I had been acquainted during my early experience. With the idea of adapting this to the wants of mill owners of small means I constructed in June, 1855, a six inch model water-wheel, with which I experimented in raising weights. In the latter part of

195 the following month (July, in the same year) I returned to Lowell and engaged myself with E. W. Scott as pattern maker and machinist. I then related what I had done to John M. Lovett, and he informed me he thought they had the same thing or nearly the same in use at the Boott Cotton Mills, in Lowell. Finding this idea was probably old, I immediately set about reading up upon the subject, and examined all the books on that subject in the City Library, Mechanics' Association Library, and all those I could find in private hands; and it was during this course of reading that the idea occurred to me as substantially shown in my patent.

Int. 10. Please now state as fully and accurately as you can, and in the order of time, just what you did in regard to the idea referred to in the latter part of your last answer and in developing the same and putting it in practical form from the time referred to in the latter part of your last answer until you made application for a patent, and until the patent was granted.

Ans. Immediately after the conception of the idea, I commenced a course of reading and study in order to inform myself of the best pro-

portions and forms and directions of the guides, and the form of the opening; also to perfect myself in drawing. I devoted all the time I could spare from my daily labor for about a year. I returned to the Lowell machine shop again in August, 1856, with a view of still further perfecting myself in the art of mechanism and turbine-wheel building. I continued there till the spring of 1859, in the mean time devoting all my leisure time, or all the time I could spare after my daily labor, to the study of the aforementioned proportions, calculating the power, making drawings and patterns for a six-inch wheel, which I completed and experimented upon in the summer of 1858. One Isaac Austin of Lowell, who witnessed some of these experiments, wanted a wheel of the same kind to drive his file-grinding stones, and with whom I made a contract to supply a thirty-inch wheel. I also made a contract with the Lowell machine shop to furnish material and finish said wheel under my direction. I proceeded at once to make designs and patterns in their employ for said wheel; as soon as could conveniently be, it was completed, set up, and set at work. This was during the month of December, same year, in his mill in Lowell. I constructed a dynamometer, and experimented upon the power of this wheel in
196 February and March, 1859, the wheel giving such good results and working in so satisfactory a manner, giving so much power, running with so little motion of its gate, that it induced several other parties to order wheels of the same size and pattern. During the year 1859 I constructed wheels of this size for John Holt, John Nesmith, and A. J. Richmond & Co., all of Lowell, and also constructed my model for the Patent Office, with a view to securing my invention. I continued to work at making wheels, devoting all my attention to them after March, 1859, until my application for a patent, up to the time the patent was granted, in May, 1860.

Int. 11. Have you the six-inch wheel which you made in the summer of 1858, which is referred to in your last answer? If so, please produce it to be filed as an exhibit in this case.

Ans. I have the wheel and now produce it.

(The exhibit above referred to and put in evidence is marked Complainant's Exhibit I, J. G. S., Examiner.)

Int. 12. Is this wheel (Exhibit I) in the same condition as when you first made and experimented with it?

Ans. It is not, exactly.

Int. 13. State in what respect it is not, and if any changes have been made, describe them particularly, and state when, by whom, and for what purpose they were made.

Ans. The bottom portion of the floats has been cut away nearly half an inch. They were cut by myself for the purpose of increasing the discharge and also to see what effect the shortening up of the floats would have upon the useful effect. As to the time when this was cut away, it was some time after it was finished and experimented on at first—just how long, I have no means of determining.

Int. 14. I notice two floats in this wheel being contiguous to each other, which are larger than the others and have a different appearance as to age, especially as to portions thereof; please examine these two floats, and state whether they are in the same condition as when the wheel was first made, and if not, what changes have been made in them, and when, and by whom, and for what purpose they were made.

Ans. They are not in the same condition, though of the same
197 form, as when first made; they were cut back the same as all the others have been. The parts having a new appearance have been

added by myself to represent, as nearly as possible, the original form in which all the said floats were made. This change was made in the (I can't recollect the date) latter part of last month.

Int. 15. State whether or not these two floats, as they now appear in this wheel, correctly represent the form, size, proportions, and position of the floats, as the floats of the wheel were when the wheel was first made.

Ans. They do.

Int. 16. Please refer to the latter part of your ninth answer and state as accurately as you can the time when the "idea" there referred to occurred to you.

Ans. I can only say that it was before cold weather—that is to say, it was warm enough to stand about the streets without discomfort, in an ordinary coat—in the year 1855.

Int. 17. When and to whom did you first communicate that "idea"?

Ans. It was in the fall of 1855, as before stated, before cold weather, and to John M. Lovett.

Int. 18. How fully, to what extent, did you make communication to said Lovett at the time referred to in your last answer?

Ans. I explained to him about the water entering the wheel; how it spread on ordinary floats; what was said to be the defect in the then turbines in use; and also explained to him the form that I proposed for the floats as best adapted to receive the impulse of the water to take from it its power or force at both full and partial gate-opening, and the direction in which the water would be discharged from the floats of the wheel; and finally, also explained to him the form of gate, the pitch of the guide, both wheel and gate substantially as they are made to day.

Int. 19. Do you know whether said Lovett understood and comprehended that communication of yours? What attention did he give to it?

Ans. I think he did comprehend it so far as the form and many of the advantages to be derived from such form were concerned. His attention had been called to those matters as well as my own,
198 and he listened with a great deal of attention and seemed very much interested, so much so that we frequently talked about it until a very late hour in the evening.

Int. 20. State as accurately as you can the time when you commenced making drawings or patterns for the six-inch wheel marked Complainant's Exhibit I.

Ans. It is impossible for me to tell the date when I began. I was at work on the wheel Fast Day, April, 1857. I have no doubt I had working drawings to work by at that time. It must have been a long time prior to that that they were commenced, because the only time I devoted to them was evenings, after the usual hours of labor had closed. Could not devote all this time evenings, because I had a family to look after; they were often sick, as well as myself.

Int. 21. Where was said Lovett living in 1857, 1858, and 1859?

Ans. In Minnesota.

Int. 22. Did you have any written correspondence with said Lovett in the years 1857 and 1858?

Ans. I did.

Int. 23. Please examine the letter now shown you, marked Complainant's Exhibit J, and to be filed in the case, and state in whose handwriting it is, when it was written, and what was then done with it, if you know.

Ans. It is without doubt in my handwriting, written in June 28, 1857. I mailed it to Mr. Lovett in Minnesota.

Int. 24. Has it been in your possession at any time since you so mailed it; if so, when and from whom did you afterwards obtain it?

Ans. It has been in my possession, as near as I can recollect, five years. I received it from Mr. Lovett in person.

Int. 25. Please examine said letter and state whether any portions thereof refer to the wheel already described by you, and of which you had conversed with said Lovett as before stated. If you find any such portions, read or point them out to the examiner.

Ans. There are such references; I point them out to the examiner, and they are by him marked in brackets, with small letters in the margin, *a* and *b*.

Int. 26. Please examine the letter now put in this case, marked
199 Complainant's Exhibit K, and state in whose writing it is, when it was written, and what was then done with it, if you know.

Ans. The letter was written by myself, March 30, 1858, and was then mailed to Mr. Lovett, in Minnesota.

Int. 27. Did it afterwards come into your possession; if so, when for the first time and from whom?

Ans. It did come into my possession; at what time I cannot say exactly; but it came into my possession last, at the same time as the exhibit marked J, and from Mr. Lovett in person.

Int. 28. I now put into the case two drawings, marked Complainant's Exhibits L and M; please examine the same, and (if you know) state what they are, or describe them; by whom and when they were made, and for what purpose, and what was afterwards done with them.

Ans. They are copies of original drawings of the wheel and connecting parts which I had described frequently to Mr. Lovett, and which were sent to him for the purpose of showing him plainly how the wheel was made, and how it might be applied and connected with a set of mill-stones for the purpose of grinding grain. These copies of drawings were made by myself sometime prior to March 30, 1858, and enclosed with a written description (Exhibit K), and sent to Mr. Lovett at that time with it.

Int. 29. Who made the original drawings from which copies Exhibits L and M were taken?

Ans. I made them.

Int. 30. How long prior to the date of letter Exhibit K, were they made? State as accurately as you can when you commenced making them.

Ans. I cannot tell. I remember having them about a long time, and spending a good deal of time on them.

Int. 31. If you have the original drawings from which Exhibits L and M are traced, please produce them to be filed in the case.

Ans. I have the original and produce it, and it is marked by the examiner "Exhibit N."

Int. 32. In your tenth answer you refer to a thirty-inch wheel made for Isaac Austin; state (if you know) how that wheel operated;
200 whether or not it gave good satisfaction; how long it was in use; whether it is still in existence; and, if so, where is it?

Ans. It operated precisely as I had been led to hope or expect, giving a very large amount of power compared to its size; running up to its working speed with a very small quantity of water; sensitive to the least motion of the gate, and every way giving the very best of satisfac-

tion. It has been in use ever since nearly all the time; it is yet in existence and in our possession at the draughting-room of complainants, and it is to be used as an exhibit in this case.

Int. 33. In your same tenth answer you say that you constructed in the year 1859 wheels of this size (thirty-inch wheels) for John Holt, John Nesmith, and A. J. Richmond & Co; how did these wheels operate and what satisfaction did they give, and how long were they in use, and where are they now?

Ans. They operated as well as the others so far as known, all gave good satisfaction; some of them are certainly in use now at the present time. One of them is run by Mr. Hall at the present time, one is in the draughting-room of complainant, to be used as an exhibit in this case; another one (the Richmond wheel) was lately sold to a party to me unknown.

Int. 34. Is the wheel just now referred to as being in the draughting-room of complainant the one made for John Nesmith?

Ans. It is.

Int. 35. It appears from your seventeenth answer that you conceived the idea of your patented wheel, substantially as afterwards made and patented, in the fall of 1855, and the patent was granted May 15, 1860; how happened it that so long a time elapsed before you obtained your patent? State generally the causes for the delay.

Ans. One reason was I wanted to make thorough work in the perfection of the thing, which would involve considerable time, even if I devoted my whole attention to it, and which I could not do for want of means, because at that time my daily bread and that of my family depended upon my daily labors. Wages were low, work at times very uncertain, sometimes not attainable at all, and considerable sickness both of myself and family; physicians' bills to pay, some assistance
201 to parents, both my own and my wife's, and a very natural desire to accumulate a little something before launching into a new thing, however hopeful it might look.

Int. 36. Who made the model which was filed in the Patent Office with your application for the patent granted you the 15th of May, 1860?

Ans. John M. Lovett did the larger portion of it, if not all.

Int. 37. Were you present when it was filed in the Patent Office?

Ans. I was not.

Int. 38. What means have you, if any, of knowing whether the very model thus spoken of was the one which was in fact filed in the Patent Office with your said application?

Ans. I have since examined the model in the Patent Office at Washington, and have no doubt it is the same.

Int. 39. Please examine Exhibit E now shown you, and state what it is.

Ans. It is one of three, of which the Patent Office model is one, made at the same time from the same patterns, and by the same person or persons.

Int. 40. Is this Exhibit E exactly like the said Patent Office model? If not, wherein does it differ?

Ans. It is as near like it as it is practicable to make two things from the same patterns.

Adjourned.

LOWELL, MASS., *Oct.* 22, 1875.

Int. 41. At or before the time of obtaining the reissue of your said letters patent, was any other model sent to or filed in the Patent Office

than the one filed with your application for the original patent, and which has already been referred to in your testimony?

Ans. No, sir.

Int. 42. Was any change made in the drawings, that were filed when the original patent was obtained, at the time when the reissue was obtained?

Ans. No, sir.

Int. 43. As my question may not be understood as intended, I
202 put it in another form: Please state whether the drawings upon which the reissue was granted are like the drawings upon which the original letters patent were granted.

Ans. They are substantially, as near as it is practical to make them.

Int. 44. Has your patented wheel been tested; if so, when, where and by whom?

Ans. It has. I tested it myself; the power of the first, thirty-inch Austin wheel, so called, in February and March, 1859. It was also tested in 1869, in Lowell, by Hiram F. Mills and James B. Francis, civil engineers; also at the Boott Cotton Mills, in August, 1874, by James B. Francis, James Emmerson; also tested one at Holyoke, in August, 1874.

Int. 45. What was the size of the wheels referred to in your last answer?

Ans. Thirty inches, forty-two inches, seventy-two inches, twenty-one and a quarter inches, respectively, in the order named.

Int. 46. Were these wheels made before or after the date of your letters patent?

Ans. The first named, thirty inch, before, all the others after.

Int. 47. State whether or not the wheels referred to as made after the letters patent were made conformably to the description in the letters patent.

Ans. Certainly, substantially so.

Int. 48. What knowledge have you in regard to the extent of the manufacture and use of your patented wheels since the date of the letters patent?

Ans. I have been intimately connected with their manufacture to the present time.

Int. 49. Please give the names of some of the principal persons and corporations, and their places of residence or business, that have used your patented water wheels; state in connection therewith, as you may remember, the size of the wheels, for what purpose used, and whether or not they gave good satisfaction.

Ans. The first prominent corporation to adopt my patent wheel was the Falls Company, Norwich, Conn.; they had eighteen-inch, thirty-
203 inch, forty-two inch and forty-eight-inch, and were compared by their superintendents with the results attained by weighing their machinery by a dynamometer, and also by indicating the power of a Corliss Steam Engine, and were considered to give very excellent results. Another was the Sohegan Manufacturing Company, Milford, N. H., two forty-two inch wheels. The Putnam Manufacturing Company, Putnam, Conn., three forty-eight-inch wheels. The Uncas Manufacturing Company, Uncasville, Conn., one forty-two inch. Stevens & Co., Haverhill, Mass., one forty-two inch, Wilton Manufacturing Company, Wilton, N. H. Charles A. Stevens, of Wareham, Mass., one thirty and one forty-two inch. The George H. Gilbert Manufacturing Company, Gilbertville, Mass., two forty-eight inch. Massachusetts Cotton Mills, Lowell, Mass., four sixty-inch wheels, one seventy-two inch. Lawrence

Manufacturing Company, two forty-eight-inch, one forty-two-inch, one twenty-four-inch, one eighty-inch. Boott Cotton Mills, one eighty-inch, two seventy-two-inch. Hamilton Manufacturing Company, one seventy-two-inch, one eighty-inch. Pacific Mills, Lawrence, Mass., one eighty-inch; and a great many others, that don't occur to me now.

Int. 50. So far as you know, or have in any way learned, state whether the wheels referred to in your last answer, and also all other wheels made under your letters patent (so far as you know, I refer especially to those of which you have personal knowledge) have given good satisfaction.

Ans. They have done so.

Int. 51. State also whether or not they have been made conformably to the description in the reissued letters patent.

Ans. They have.

Adjourned.

BOSTON, *Nov.* 14, 1875.

Int. 52. It appears from the testimony of John L. Stowe that the wheel claimed to have been made by him in 1837 was propelled by water passing through a spout which had a discharge opening, in form of a parallelogram, measuring six inches by twelve inches, with a fall of twelve feet; please state how many cubic feet of water would pass through the opening of that spout per minute. Also state the gross power of the water so passing through.

204 Ans. Such an opening would discharge five hundred cubic feet per minute; the gross power would be equal to eleven and one-third horse power.

Int. 53. It also appears by the testimony of said Stowe that the wheel claimed to have been made by him in 1841 had a similar discharge opening, measuring four inches by eight, with a fall of ten feet; how many cubic feet of water would be discharged per minute through that opening? And what would be the gross power of the water so passing through?

Ans. Such an opening would discharge two hundred and seven and one-fourth cubic feet per minute, and the gross power would be three and nine-tenths horse-power.

Int. 54. It also appears by said Stowe's testimony that the wheel claimed to have been made by him in 1856 was propelled by water, passing through a similar spout and opening as the 1841 wheel, with a fall of eleven feet; how many cubic feet of water would pass through the opening in this case, per minute? And what would be the gross power of the water so passing through?

Ans. The quantity of water would be two hundred and seventeen and three-eighths cubic feet per minute, and the gross power would be four and one-half horse-power.

Int. 55. Have you carefully examined defendant's "Exhibit Sketch of 1837 Wheel," and if so, do you understand what type of wheel it represents?

Ans. I have. It clearly belongs to that class of wheels known as "spoon wheels."

Int. 56. Have you been acquainted with the practical working of that class of wheels?

Ans. I have.

Int. 57. Do you know the percentage of useful effect for the water used which said wheels utilize?

Ans. I know that many of them do not exceed 15 per cent., and none

of them are rated over 33 per cent. by intelligent engineers, based on their experiments.

Int. 58. Are you familiar with the "Jonval wheel," so called?

Ans. I am, sir.

205 Int. 59. Please state whether a Jonval wheel, properly constructed, can have the discharge edge of its buckets extend from the periphery or outer edge of the wheel to the centre of the wheel?

Ans. No, it cannot; very far from it.

Int. 60. Why not?

Ans. Because the velocity of the edge of the float receiving the water, and the edge discharging the water, must bear a certain relation to the velocity due the fall acting upon the float, in order to receive and properly transmit into useful effect the force or power in the moving body of water; and this relation cannot be varied materially more than 10 per cent. between the inner and outer extremity of the floats without serious loss of useful effect.

Int. 61. Have you examined complainant's Exhibit D, being the thirty-inch wheel referred to on page 13 of the printed record in this case?

Ans. I have.

Int. 62. Have you seen and examined such wheels as are described and referred to on page 13 of the printed record in this case, set up, complete, and in readiness for sale and use? If yea, where did you see such wheels?

Ans. I have; at Bristol, Conn., in the shop-yard of the National Water Wheel Co.

Int. 63. Please state whether you received from said National Water Wheel Co. one of their pamphlets or publications, giving a description and illustration of the wheels you referred to in your last answer. If yea, please produce the same, and state when you received it.

Ans. I have received such a publication; I produce it, and it is marked Complainant's Exhibit O, J. G. S., examiner. I received it in February, 1875.

Int. 64. Please examine the two leaves inserted in this Exhibit O, immediately following page 22, and state whether said printed leaves were received in said exhibit at the same time, and as they now appear.

Ans. They were received at the same time and in the same form as they now appear.

Int. 65. Please examine page 4 of said Exhibit O, and state

206 whether figures "No. 2" and "No. 3" illustrate such wheels as you saw, and to which you refer in your sixty-first and sixty-second answers, and such as are referred to in page 13 of the printed record.

Ans. They do illustrate those wheels, so far as the wheel and floats for receiving the water and the guides for directing the water upon the floats of the wheel are concerned.

Int. 66. Do you know from actual observation and experience how the water enters your said patented wheel when it is in operation, and how it passes through it and is discharged from it?

Ans. I do.

Int. 67. Please now state how or in what direction the water enters the wheel when it is in operation?

Ans. It enters the wheel nearly at a tangent to the outer circumference and horizontally.

Int. 68. State generally how or in what direction or directions the water passes through the wheel when it is in operation?

Ans. The water is divided into different lamina vertically by the

guides as the wheel rotates past each succeeding guide, receiving one lamina after the other. Each preceding lamina or stream is crowded or forced inward, radially at first, by the succeeding laminæ or streams, the upper portion continuing with this inward motion, and having also a motion of rotation with the wheel or turbine, while that portion received at the bottom of the inlet is crowded or forced downward by each succeeding lamina or stream, the portions between, assuming intermediate directions, all moving in the radial plane, inward and downward, and at all the possible angles between the inward and downward, until it reaches the upper portion of the vertical and inner edge of the float, the lower and outer and horizontal edge of the float, and all intermediate points of the edge of the float, and in proportion, as to quantity, to the area or space under the floats and inside of the floats provided for its discharge or escape after leaving the floats.

Each particle of water travels in a much longer distance, nearly one-fourth of the distance around the wheel, during the time in which it is passing from the outer to the inner edge of the floats, as well as the lower or bottom edge of the floats, while it has been moving in the
207 radial plane before mentioned. The upper portions of the successive laminæ really move in a line with a very slight inclination to the plane of the wheel's motion; that is to say, slightly downward from the horizontal, until leaving the inner and upper edge of the float, between said float and the hub of the wheel, when it is turned downward by an easy curve of said hub, or the coupling in connection with that and the crown of the wheel.

Int. 69. How or in what direction or directions does the water leave the floats, or is discharged therefrom?

Ans. That which enters the wheel at the top of the opening is discharged directly inward towards the centre of the wheel; that which enters at the bottom of the opening is discharged vertically or downward. The portions between the top and bottom of the inlet are discharged in the radial and vertical planes, varying from horizontally towards the centre, and at all angles in said planes to the outside edge and vertical line of discharge.

Ans. 70. After the water has left the discharge edge of the floats, into what space does it flow, or how does it escape from the wheel so as to offer no obstruction?

Ans. That which enters the wheel at the upper portion of the inlet flows into the space under the centre of the wheel and inside the inner edges of the floats. The portion entering at the bottom of the inlet flows into the annular space outside the inner edges and immediately under that occupied by the floats, neither interfering with the other, each having a space of its own; the central flow having the space of a central discharge wheel, and the downward flow the annular space of a Jonval wheel.

Int. 71. In your forty-fourth and forty-fifth answers you speak of several of your wheels having been tested; state, if you can, the result of each or any of said tests, referring to, and presenting to be filed as exhibits, whatever you may have (if anything) to aid or refresh your recollection.

Ans. The thirty-inch Austin wheel, so called, tested by myself, gave $2\frac{73}{100}$ horse-power on a fall of $3\frac{1}{2}$ feet, said wheel being submerged by back water $6\frac{1}{2}$ feet, carrying a pair of beveled gears with 22 feet of 3-inch horizontal shaft. The forty-two-inch wheels tested by Mr.
208 Mills and Mr. Francis, in the year 1869, gave $68\frac{2}{10}$ horse-power on a fall of $13\frac{82}{100}$ feet, the ratio of useful effect being $81\frac{9}{10}$ per cent.

The seventy-two-inch, tested by Mr. Francis at the Boott Cotton Mills, in August, 1874, gave $191\frac{6}{10}$ horse-power under $12\frac{4}{10}$ feet head, giving a useful effect of $83\frac{85}{100}$ per cent. I now produce a copy of the record of Mr. Mills' tests, to be marked Exhibit P, J. G. S., examiner, and also produce a copy of Mr. Francis' test of the Boott wheel, to be marked Exhibit Q, J. G. S., examiner.

Int. 72. Please state how these tested wheels, as to their construction, principle, operation, and effect, compare with the Nesmith wheel, so called by you in your testimony, and with the complainant's Exhibits E, F, and I.

Ans. They are all substantially the same as to their construction, principle, operation, and effect.

Int. 73. Have you examined, and are you familiar with complainant's Exhibits G and H?

A. I have examined them, and made myself quite familiar with them.

Int. 74. State whether each of these wheels is made in all respects in proper proportion throughout in relation to their respective diameters, in order to conform to the best authorities?

Ans. They are so constructed.

Int. 75. Please state, if you can, the capacity of your patented wheel, as compared with the capacity of the two last-named (Exhibits G and H), supposing the diameters to be the same.

Ans. The central discharge or Exhibit G would be 27 per cent. of the capacity of my patent wheel, or Exhibit E and the Jonval wheel (Exhibit H) would be 33 per cent. of the power of my patented wheel, Exhibit E.

Int. 76. In your thirty-sixth to fortieth answers you speak of Exhibit E as being like the model filed in the Patent Office. In examining the certified copies of the drawings filed in this case I notice drawings of additional pieces forming a part of said wheel. If you have duplicates of such parts made at the same time and by the same person, please produce the same to be marked in the same manner as the part already referred to.

Ans. I have, and I here produce the same to be so marked.

209 Int. 77. Please state whether duplicates of the pieces just produced and marked were filed in the Patent Office with your application for a patent, as a part of your model.

Ans. They were.

Int. 78. In your forty-eighth answer do you refer only to the manufacture of your patented wheels by yourself, or do you also include the wheels manufactured by the Swain Turbine Co., and the Swain Turbine and Manufacturing Co.?

Ans. I refer to each and all of the parties named.

Int. 79. Was there any piece or casting made to go with and as part of the wheel marked Exhibit F, to be secured to the shaft on the inside of the wheel? If so, please produce it to be marked in the same manner.

Ans. There was; and I here produce it, and it is marked as above.

Adjourned.

BOSTON, *Nov.* 10, 1875.

Int. 80. For what purpose or use is the coupling referred to in your last answer? I mean the piece or casting produced in connection with that answer.

Ans. It is for the purpose of preventing any eddies or whirling of the water in the angle or corner under the wheel-coupling (made by the crown

of the wheel and the wheel shaft), and to keep the water in a regular and uniform current after its discharge from the wheel.

Int. 81. Suppose you regard the water as it enters your wheel as being divided into ten equal horizontal sections or laminæ, would such sections or laminæ maintain the same condition and relation to each other upon reaching the discharge edge of the floats? If not, wherein would they differ?

Would there be any further variation on their reaching a horizontal plane extending from the lower edge of the band of the wheel to the centre of the wheel; and if any further variations or differences, what differences would be found there?

Ans. They would not maintain the same relation to each other as to the direction of their motion. The water entering the wheel
210 horizontally in the direction of the pitch of the guides is divided by said guides into as many streams or laminæ vertically as there are spaces between the guides, each and all of them seeking the path of least resistance into, through, and in its escape from the wheel. If these same streams or laminæ were divided horizontally into ten equal sections, each section would become in a measure independent of the others, though each seeking by itself the path of least resistance through the wheel as before. This resistance depends upon the form of the floats and upon the cross sectional area through which these streams or laminæ must pass in their path through the wheel.

My patented wheel has always been so designed and made that the successive cross-sectional areas gradually increase as these streams or laminæ flow through the wheel, thereby diminishing the resistance in this respect, whereas the floats are so formed that they resist and gradually retard the velocity of this flow just in proportion as the cross-sectional area is properly increased, and to gradually change the direction of this flow until at the moment of leaving the discharge edge of the floats portions of them would be moving in lines towards the centre of the wheel, and other portions downward and parallel with the axis of the wheel; and all in a plane parallel with or cutting the axis of the wheel.

On reaching a horizontal plane extending from the lower band of the wheel to the centre of the wheel, they would all have changed the direction of their flow from an entire horizontal one on entering the wheel to horizontal and vertical ones on leaving the edge of the floats, and to a vertical one on reaching this plane. The lamina entering the wheel at the top would then occupy an annular space around the centre of the wheel equal to one-tenth of the area of the clear space between said wheel centre and the outer band of the wheel. The lamina entering the wheel at the bottom of the opening would occupy an annular space next to the outer band of the wheel and equal to one-tenth of the area or clear space between said band and the centre of the wheel. The intermediate laminæ would occupy the intermediate annular spaces or areas in said planes. The divisions at the point of entering the wheel being equal, equal proportions of water would enter said divisions; the width
211 and cross-sections of the upper and lower laminæ will begin to differ in form as soon as they enter the wheel, the one entering at the bottom increasing a very little in a radial or central direction in passing through the wheel into the outer annular space, whereas the one entering at the top increases regularly in section on a radial plane in passing through the wheel, and after leaving the discharge edge of the floats, and to the moment of passing the horizontal plane before mentioned, and because the space or area is less as it approaches the centre

of the wheel. The inner annular space for the upper lamina must needs be much the widest on said plane, or any other plane cutting the axis of the wheel, and each of the next adjacent nine annular spaces will be narrower as the outer band is approached on said plane; their width radially must be in proportion to the difference of the square of their diameter.

Int. 82. What portion or per cent. of the ten sections or laminæ of water referred to in your last answer would operate upon the centre vent part of your wheel?

Ans. About three and a half of these divisions, or a little over thirty-five per cent.

Int. 83. What portion of the space under the wheel will be occupied by the thirty-five per cent. of the water just stated by you as operating on the centre vent part of your wheel? I mean, how much area, and where that area is located as to the rest of the space under the wheel.

Ans. The proportion of the space is in proportion to the water in the last answer, thirty-five per cent. This space is located under that part of the wheel within the inner edges of the floats, and outside of the wheel coupling.

Int. 84. Does this thirty-five per cent. of water (discharged by the centre vent part of your wheel) flow into or occupy any of the space immediately under the wheel, due to the water discharging from the bottom or Jonval part of the floats of your wheel?

Ans. It does not.

Int. 85. Is there outside of the space occupied by the discharging water from the centre vent part of your wheel (as referred to by you in your last answer) ample room or space for all the water discharg-
212 ing from the Jonval or lower part of your floats to pass into and off immediately under your wheel without in any way occupying any of the space due to the water discharging from the centre vent part of your wheel, and without being disturbed by the water discharged from the centre vent part of your wheel?

Ans. There is.

Int. 86. Is the space occupied for the discharging water from the Jonval part of your wheel (referred to in your last answer) of as great capacity as is required in any properly constructed Jonval wheel of similar diameter?

Ans. It is as great, or greater.

Int. 87. In your last answers, do you refer to your model Exhibit E, or to other wheels made under your patent?

Ans. Particularly to that and to all others manufactured under the patent by myself and complainant.

Int. 88. How does the capacity of the centre vent part of your wheels compare with the capacity of such centre vent wheels as were in operation at and prior to your patent?

Ans. The capacity is as great or greater than any centre vent wheel that had to my knowledge ever been constructed up to the date of my patent.

Int. 89. Please state, generally, the extent of your knowledge of centre vent wheels that had been constructed prior to the date of your patent. I refer as well to the different kinds or styles of centre vent wheels you may have seen as to their number.

Ans. I had known and examined as to capacity and form Warren's centre vent wheel, Blake's centre vent wheel, the Howd patent or United States centre vent wheel; and I had particularly examined the drawings of the Boott centre vent wheels, designed by Mr. Francis, of Lowell,

and examined carefully the date in regard to experiments made by him upon those wheels, all the particulars of which are to be found in his work, entitled "Lowell Hydraulic Experiments." I had also read a description of Mr. Boyden's patent centre-vent wheel, published in the "Patent Office Reports" for the year 1853. There were many others of less elaborate make which I had seen made by different mechanics and millwrights, but without any special name.

Int. 90. How does the capacity of the Jonval or lower part of
213 your wheel compare with the capacity of such Jonval wheels as existed before the date of your patent?

Ans. The capacity is equal to or greater than any that had been made up to that time.

Int. 91. In your tenth and thirty-second answers you refer to a thirty-inch wheel made for Isaac Austin; can you produce that wheel? If yea, please do so, to be introduced and marked as an exhibit in this case.

Ans. I can do so, and produce it.

(The wheel introduced and put in evidence is marked Complainant's Exhibit R, J. G. S., examiner.)

Int. 92. In your tenth and thirty-third answers you refer to a thirty-inch wheel made for John Nesmith; can you produce that wheel? If yea, please do so, that it may be introduced as an exhibit in this case and marked.

Ans. I can, and produce it.

(The wheel referred to in the last answer is marked Complainant's Exhibit S, J. G. S., examiner.)

Int. 93. I now introduce a wheel marked by the examiner Complainant's Exhibit T; please state when you first saw this wheel, and where, and in what condition it was.

Ans. I think it was about the middle of September last that I first saw the wheel. I couldn't give the date without referring to a memorandum made at the time; it was in the mill of Jotham Hartshorne, said to be in Amherst, N. H., and located about two miles from Milford Station, N. H. It is in good running order apparently substantially as now seen, except the shaft has been removed.

Int. 94. What is the object of the crown of your patented wheel? For what purpose is it made?

Ans. The object of the crown is threefold; but chiefly to hold firmly the upper ends of the floats of the wheel, and to form a connection between the floats and the shaft of the wheel, and as an upper wall between the floats of the wheel.

Int. 95. Please examine the crowns in complainant's Exhibits E, I, R, and S, and state what differences you observe in them, and why such differences were made, and (if you know) what effect, if any,
214 was produced by such differences in the capacity or operation of the wheels?

Ans. I have examined the exhibits named, and find the crowns in the exhibits marked E and R curved a little downward from near the outer edges of the floats to their inner edges. The crown of exhibit marked I is perfectly horizontal in its entire width; and that of exhibit marked S is straight, but inclined very slightly to the plane of the wheel from the outer edges of the floats to their inner edges. These differences were considered immaterial, so far as the character of the wheel was concerned, one being a well known substitute for the other. The curved form was given them in order to avoid any sudden change in the direction of the water near to or at the point of leaving or immediately after leaving the discharge orifice of the floats of the wheel. The effect was

to lessen the resistance to the final escape of the water from the wheel after doing its work, and therefore to allow a greater quantity of water to be applied to a wheel of any given diameter without overloading it as to quantity, and consequently increasing its capacity and useful effect.

Adjourned.

BOSTON, *Nov.* 11, 1875.

Int. 96. In what form have you made the crown for your wheels since the date of your patent; and in what form have your assignees made the same since they commenced making them?

A. Substantially as shown in complainant's Exhibit P, Plate 2, Fig. 1, and also in complainant's Exhibit Q, Plate 3, Fig. 1; also in complainant's exhibit marked S, being the Nesmith wheel, so called.

Int. 97. Please state what knowledge you had before the invention of your patented wheel as to the form of the crowns of centre vent turbines; and describe the form or forms of the crowns of such turbines, so known by you, as fully as you can.

Ans. I was familiar with the Howd, Blake, Warren, Boyden, and Francis centre vent turbines. The Howd centre vent turbine had an upper and a lower horizontal crown, between which the floats were fixed. The Blake centre vent had an upper and a lower crown, both beveled or inclined downward towards the centre; the upper one
215 being about three inches lower at its inner edge than at its outer edge in a width of fourteen inches, the lower crown having an inclination of four and three-fourth inches in the same width. In the Warren centre vent, both crowns were horizontal their entire width. The Boyden centre vent had both upper and lower crowns curved downwards towards the axis of the turbine, the lower one more than the upper one; the curve on the under side of the upper one was on a radius a little greater than the radius of its outer edge. Of the Francis centre vents, some had horizontal crowns at both top and bottom, some had both crowns curved, their inner and outer edges being nearly of the same height horizontally, but of a less height near the middle of their width, the surface of each being convex from their outer to their inner edges on their face side.

Int. 98. Was there any substantial difference in the operation and practical effect of the water acting upon these turbines in consequence of the differences you have described in their crowns? If yea, state what differences fully.

Ans. There was no substantial difference.

Int. 99. Were the different crowns, described and referred to in your ninety-seventh answer, generally known and in general use prior to the date of your invention? And state whether or not they were then well known as equivalents for each other.

Ans. They were generally known and in general use years prior to the date of my invention, and were known to me years prior as well known equivalents one for the other.

Int. 100. What knowledge of the Jonval turbines receiving the water horizontally had you prior to the date of your invention or letters patent? And please describe the construction of any such that you now call to mind.

Ans. I knew of the Dripps patent, the Van Dewater, the Burnham and the Whitney patent turbines thus receiving the water. In Dripps' patent, the water was directed by a series of guides surrounding the wheel against the outer edges of the buckets. These buckets were fixed

to the outside of a cylinder extending to their bottom edges, and were so constructed as to discharge the water used into a narrow an-
216 nular space, immediately under the space occupied by said buckets. The Van Dewater patented turbine had also a series of guides to direct the water upon the outside edges of the buckets; these buckets were attached, at their top edges, to a crown nearly horizontal, and also to a plane cylinder by their inner edges their entire depth from top to bottom. In the Burnham turbines there was also a series of guides to direct the water against the outer edges of the buckets; these buckets were attached to a curved crown with a cone centre, merging into and forming a plain cylindrical inner wall, extending to their bottom edges, and to which they were fastened from their extreme outer and upper edges to their inner and bottom edges; and so constructed as to discharge the water used, downward or vertically, into an annular space or area immediately under the space occupied by said buckets. In the Whitney wheel, so called, the water was received upon the outer edges of the buckets, as in the others; these buckets were attached to a similarly curved crown and conical centre and inner cylindrical wall, as were those of the Burnham wheel; in addition, the buckets were stayed at their outer and lower portions by a cylindrical band, to which they were fixed; and its construction and operation, effect, and the discharge of the water were precisely like the others mentioned in this answer.

Int. 101. Please state how the Whitney wheel, described in your last answer, compares with complainant's Exhibit T.

Ans. They are both alike; that is, substantially the same as described.

Int. 102. I now put into the case four drawings marked Complainant's Exhibits U^1, U^2, U^3, and U^4, J. G. S., examiner; please state, if you know, what they are, and when and by whom made, and for what purpose.

Ans. They are drawings of my patented wheel, made by my own hand in the fall of 1860 and winter of 1861; they were for working drawings of a forty-two-inch wheel.

Int. 103. I now put into the case a certified copy from the Patent Office of the drawing upon which the reissues of the Leffel patent was granted, marked Complainant's Exhibit V, J. G. S., examiner; please examine said copy, and state whether you know what it represents.

217 Ans. I have examined it, and find it represents the Leffel patent wheel.

Int. 104. Have you seen wheels made by the owners of said Leffel patent; if yea, how were they constructed? I refer particularly to the upper crown of the centre vent part of said wheel.

Ans. I have seen several of them, and find the buckets of the centre discharge portion fixed to a curved upper crown, substantially like the upper crown of the Boyden centre vent turbine, referred to in my ninety-seventh answer.

Int. 105. Please state whether the upper part of your turbine, as patented, has all the elements for effectively utilizing the power of the water, applied to and operating in that part of it, and for disposing of the water after its power is utilized, that any properly constructed centre vent turbine has.

Ans. It has.

Int. 106. I now put into the case a certified copy from the Patent Office of the drawing connected with your original letters patent, and being part of the same and marked Complainant's Exhibit W, J. G. S., Examiner. Have you compared this drawing with the drawing of

your reissued letters patent? If yea, state whether they are or are not alike.

Ans. I have examined them, and find them substantially alike.

Int. 107. I now call your attention to Complainant's Exhibit E; please state who made the same, and for what purpose.

Ans. It was made by John M. Lovett, and for the purpose of showing (without so much regard to nice or the best proportions) substantially the form and construction of my newly-invented turbine.

Int. 108. It appears from exhibits in this case (particularly Complainant's Exhibit W) that Munn & Co. were your attorneys in procuring your original letters patent; where did they reside while transacting that business?

Ans. In the city of New York.

Int. 109. Prior to the receipt of your letters patent, did you have any personal interview with them, or with any member or employé of their firm?

218 Ans. I did not.

Int. 110. Who prepared for you the application for your patent and the specification and drawing accompanying it?

Ans. They were prepared by Munn & Co.

Int. 111. What did you send or furnish them with for that purpose?

Ans. I sent them a model, a duplicate of Complainant's Exhibit E, and also a writing of what I thought was new in it.

Int. 112. In the "schedule" or specification referred to in your original letters patent, and making a part of the same, is the following extract:

"When J is lowered the water strikes the floats with all the force and velocity due to its head, directly under the rim of the wheel, which is so curved as to force the water down rapidly on the lower curved parts or bottoms of the floats, the water not leaving the wheel until its force has been properly expended on it." Please state whether, in any communication to said Munn & Co., you requested to have any such specification or statement, either in its language or its substance, inserted in the "schedule."

Ans. I did not.

Int. 113. After the application and schedule had been prepared by Munn & Co. were they sent to you to be signed? If yea, to what place?

Ans. They were sent to me, at Lowell, Mass.

Int. 114. Why did you not have the paragraph which is in quotation marks, in the one hundred and twelfth interrogatory, stricken out before signing?

Ans. I relied upon them to prepare the specification, and did not give it that attention, perhaps, that I should; certainly not so much to that part as I did to the description of the mechanical part of the apparatus. I was also entirely unused to matters of that kind.

Int. 115. When did you first know that said quoted paragraph was in the "schedule"?

Ans. I can't tell the year positively; I think it was in the fall of the year that the patent was granted.

Adjourned.

219 BOSTON, *Nov.* 12, 1875.

Int. 116. In your original patent, there does not appear to be any specific claim for that part of your turbine consisting of the crown, buckets, and band, while in the reissue these parts seem to be specifically claimed. Why were they not so claimed in the original?

Ans. I knew nothing of patent matter at that time, and sent my model with a letter to Munn & Co. to get me a patent, supposing they would do the business right. When the papers came to me to be signed I hurriedly glanced them over, and finding they had described the different parts I supposed that was all that was required. I didn't then know that all I wished to secure must be put in claims at the end of the specification. It was some time after, nearly a year, that I learned and noticed that my patent was defective, and that all these parts had not been secured.

Int. 117. After you found your letters patent were defective what (if anything) did you do?

Ans. As soon as I could I went to see Munn & Co., to learn what, if anything, could be done about it, and they told me that it could all be corrected at any time by a reissue.

Int. 118. Why didn't you obtain a reissue before November, 1872?

Ans. Immediately thereafter the hard war times came on, all the mills in Lowell stopped, and all kinds of business came to a standstill. I had used all my means in trying to introduce my invention into use, which was very expensive and difficult. Then, as I was getting a little started I was burned out, losing everything, and I was obliged to sell my patent.

Int. 119. At the time when the reissue was granted were there persons and corporations infringing your letters patent, and did they, upon being notified of the reissue, stop infringing or take licenses? If yea, please give the names of such as occur to you that were so infringing, or stopped and took licenses, and state generally the extent of their business and their intelligence.

Ans. There were a large number of them so infringing. Many of them were well-informed manufacturers, with ample means and facili-
220 ties for doing a large business. Amongst those of them who have taken licenses are the Rodney Hunt Machine Co.; Lane Manufacturing Co.; Cole Manufacturing Co.; Newburgh Company; Dwight Cushman; Waldo Whitney; and Stetson & Townsend. Those of them who have stopped infringing are the Holyoke Machine Co.; T. H. Risdon; Tyler & Co.; Peck & Teachout; Hodge, Herman & Herchelrode Manufacturing Co.; and many others.

Int. 120. Had any of the infringing wheels referred to in your last answer horizontal crowns similar to the crown of defendant's wheel marked Complainant's Exhibit D; if yea, whose, so far as you remember?

Ans. The crowns of the Rodney Hunt wheel, Lane Company's wheel, the Cole Company's wheel, Whitney's wheel, and the Stetson wheel, all had horizontal crowns substantially like the crown of defendant's wheel referred to.

Int. 121. Have you any circular of said Whitney, illustrating the wheel called in your last answer "Whitney wheel"; if so, please produce it, to be marked Complainant's Exhibit X, J. G. S., Examiner.

Ans. I have such circular, and now produce it.

(The circular referred to is marked by the examiner Complainant's Exhibit X, J. G. S., Examiner.)

Int. 122. In another part of your testimony you have spoken of the Whitney wheel, marked Complainant's Exhibit T; is that a wheel of different construction from the one illustrated on Complainant's Exhibit X, and referred to in your one hundred and twentieth and one hundred and twenty-first answers?

A. It is of different construction.

Int. 123. In a previous part of your testimony you have spoken of the water as entering the buckets of your wheel tangentially; does the water leave the discharge edges of said buckets tangentially; if not, how does it leave them?

Ans. It does not; it leaves radially inward and radially, or, in a radial plane, downward.

Int. 124. What causes the change from tangential on entering to radial on leaving the floats?

Ans. The form of the buckets.

221 (Counsel for complainant here puts into the case a certified duplicate from the Patent Office of the model in the matter of the letters patent granted John Haseltine, dated March 25, 1866, marked Complainant's Exhibit Y, J. G. S., Examiner; also a certified duplicate from the Patent Office of the four models in the matter of the letters patent granted A. Greenleaf, dated May 16, 1854, marked Complainant's Exhibit Z, J. G. S., Examiner.)

Int. 125. Were there guides to direct the water on to Complainant's Exhibit R and S such as are shown in Complainant's Exhibit W?

Ans. There were.

Int. 126. Have you a circular received by you from Waldo Whitney? If so, please produce it, to be marked Complainant's Exhibit A′, J. G. S., Examiner, and state when you received it. Have you also one of said Whitney's descriptive pamphlets? If so, please produce it, to be marked Complainant's Exhibit B′, J. G. S., Examiner.

Ans. I have, and produce it, and it is marked Complainant's Exhibit A′ by the examiner. I think I received it as early as 1865. I have one of said pamphlets and produce it, and it is marked by the examiner Complainant's Exhibit B′.

Int. 127. Have you carefully examined the testimony of John L. Stowe in this case, so far as it is descriptive of the wheels claimed to have been made by him in 1837, 1841 and 1850, and the exhibits referred to by him and relating to said wheels? Have you also carefully examined the Greenleaf patent, Defendant's Exhibit No. 10, and the four certified models, Complainant's Exhibit L? Have you also carefully examined the description in the Whitney patent, Defendant's Exhibit No. 11, and the Hartshorne wheel, so called, being Complainant's Exhibit T? And have you also carefully examined the Temple patent, Defendant's Exhibit No. 12? Do you understand the principle, construction, operation and effect of each of the four whees above referred to? If yea, please state wherein each of them differs l(if any difference exists) from your patented turbine.

Adjourned.

222 BOSTON, *Nov.* 13, 1875.

Ans. I have examined the testimony and the exhibits named in the last interrogatory and think I understand them fully. My patented wheel is a new and distinct type of turbine, having all the elements for utilizing the power of the water in the well-known centre-vent and Jonval turbines, together with many features unknown before my invention. It has buckets so formed and constructed at their upper portions as to effectively utilize the power of the water acting on the upper part of them, as in a centre-vent wheel, together w th ample room or area inside the inner edges of this portion of the buckets for the discharged water to pass into and off without occupying any of the space due to the water discharged from the Jonval or lower part of the buckets. It also has these buckets so shaped and constructed at their lower portions as to effectively utilize the power of the water acting on

the lower portions of them, as in a downward vent or Jonval wheel, with ample room under the buckets for the discharged water to pass into and off without occupying any of the space due to the water discharged from the centre-vent or upper portion of the buckets. It also has a circular series of guides for directing the water on to the buckets and a gate to regulate the quantity of water used. The defendant's turbine is substantially the same in principle, construction and operation, it having buckets so shaped and constructed at their upper portions as to effectively utilize the power of the water acting upon the upper parts of them as in a contrevent wheel, together with room or area inside of the inner edges of this portion of the buckets for the discharged water to pass into and off without occupying any of the space due to the water discharged by the Jonval or lower parts of the buckets. It also has these buckets so shaped and constructed at their lower portions as to effectively utilize the power of the water acting upon the lower portions of them, as in a downward vent or Jonval turbine, with room or space under the buckets for the discharged water to pass into and off without occupying any of the space due to the water discharged from the centre-vent or upper portion of the buckets. It also has a circular series of guides for directing the water to the buckets of this turbine, and a gate to regulate the quantity of water used.

223 The Stowe wheel, as described by him in his testimony in this case, and shown in defendants' exhibits to which my attention has been called, has none of the elements of, nor is it in any sense a turbine, not having a series of guides, which are indispensable to all turbines; but it is one of that very old class of wheels known and described in works on hydraulic motors as "spout" or "spoon wheel," in which the water acts by percussion or impulse alone, while in the turbine it acts by direct pressure throughout its entire course through the wheel. The water is applied, used and discharged in nearly the same direct or tangential line, and could not possibly be discharged radially towards the centre, and but a small portion of it downward, the water merely plunges in between and against the buckets from a single spout on the outside, and out again as soon as the buckets between which it has entered have passed the end of the spout or curb, and really changing its course or direction but 30°, whereas in all well constructed turbines its change from a tangential to radial direction, as in the centre-vent turbine, or to a vertical one, as in the Jonval turbine, and also as in any patented turbine, is 90°; nor can the course of the water vary many degrees from this and be effectively utilized while acting upon them. Another inseparable characteristic of all turbines is that they operate as well, or better, "when submerged in the water of the lower level," or tail race; whereas the Stowe wheel, under like conditions, would be totally and utterly useless. If any water did pass into the space inside the inner edges of the buckets of this wheel it could not possibly enter that space radially, but must move between the arms in a tangential direction instead of radially.

The "gravity and percussion water power machine" of A. Greenleaf, as shown by the exhibits in this case, to which my attention has also been called, belongs to the well-known type of "reaction water-wheels," so called, "invented or introduced in this vicinity by Calvin Wing" some forty-five years ago, and described as such by many writers of note upon hydraulics and mill work.

These exhibits are distinguished from my patented wheel by the absence of the ever indispensable series of guides found in all turbines.

This Greenleaf machine is a double vertical wheel on a horizontal

224 axis, and cannot be operated "submerged in the water of the lower level;" it is entirely wanting in the first principles of the turbine. The form and construction of the buckets are entirely different, and are made for a different operation of the water on them; also by the fact that they require to be run at a speed when loaded, or when doing their best work, that a turbine or any direct pressure wheel cannot approach, even without any load, and at more than twice the speed of the water that propels them, and from three to four times as fast as the turbine; also by the fact that their speed is very irregular under the slightest changes of load, and that they will oftentimes scarcely start of themselves, as they must have considerable speed before they begin to utilize the power of the water; whereas my patented wheel will draw the heaviest load just as it starts, and will exert the greatest force at a "dead pull," as is the case with all other turbines. If the water was directed upon the buckets, these buckets, by the very best devised series of guides, it would still remain one of the same impracticable, unsteady, flighty, and most extravagant motors (in the expense of water) that were ever made. It has not in principle, construction, operation or effect any of the elements of my turbine. Another distinguishing feature is the fact that wheels made like the exhibits named would discharge a quantity of water three or four times as great in proportion to the area of the issues as does any well (or even an indifferently) proportioned turbine. The water acts upon these buckets, to propel the wheel, precisely as the fibre of a block of wood would act upon the threads of a wood screw if one attempted to turn the screw by pressing the block or fibre against the threaded and pointed end of the screw. The surface of the bucket is so little inclined to the service of rotation of the wheel that much the greater action of the water is expended as a crushing force upon the wheel; and were the water the object to be driven, and the wheel made the driver, power being applied by any of the usual means to the shaft of the wheel, it would do vastly the best service as a pump.

The description of the Whitney wheel in his letters patent is substantially that of the Hartshorne wheel made by said Whitney, and marked "Complainant's Exhibit T," and to which my attention has been called, is a very poor specimen of a numerous class of
225 Jonval, or downward vent, and well-known type of wheel, first patented by James Pitting, Feb. 3, 1834, but now more generally and better known as the Burnham type of Jonval wheel. This wheel has a narrow, curved crown, merging into a curved, inverted, conical centre, and ends in a vertical, cylindrical inner wall, to which the buckets are attached at their top, and continuously from their outer edges to their inner lower edges. The water is received horizontally and tangentially, substantially as in my patented turbine, but the water, instead of any portion of it being discharged radially towards the centre of the wheel, is turned downward by the inverted conical centre, and the inner vertical wall to which the buckets are attached; and this downward direction is acquired and complete entirely within and before reaching the discharge edge of the buckets. There isn't a single element of a centre-vent wheel in it. It hasn't the shape or construction of bucket incident to or required in a centre-vent wheel. It hasn't the space of area under the centre of the wheel within the inner edges of the buckets for the water to discharge into from the upper portion of the buckets, and to pass off in; but all the water was discharged from the Jonval or lower part of the buckets. It is simply a poor type of Jonval wheel, as experience and tests many times repeated (of

which I am personally familiar) conclusively show; its capacity and percentage of useful effect being less or below even an ordinary Jonval turbine. The operation of the water on the wheel and discharge from it is as he states in his circulars and pamphlets in this case as exhibits. It has substantially no crown, no inner discharge line of the buckets, no effective inward flow and discharge of part of the water, no buckets formed and constructed, and no space under the centre of the wheel inside of the inner edges of the buckets similar to all of those found in my turbine. It is substantially the Haseltine bucket with a conical centre instead of the hub with vertical sides, as in the Haseltine wheel. The coupling in my patented wheel is a very different thing, and for a very different purpose from that of Whitney's inverted conical centre. My coupling effects its purpose after the water has done all of its work upon the wheel; his conical centre effects its purpose while the
226 water is flowing through the wheel, and is completed before the water reaches the discharge edges of the buckets. There is no such combination of the elements of an effective inward flow and discharge of part of the water, and an effective downward flow and discharge of part of the water, with proper areas or spaces for each, as in my patented wheel. It is simply clipped off a little at the bottom of the inner vertical wall, as the well-known Risdon and Burnham wheels are, sometimes on one side and sometimes on the other.

The Temple wheel, as described and shown by the exhibits to which my attention has been called, receives the water horizontally and tangentially, and portions of said water were no doubt discharged radially through "the crown of the wheel," being "for a distance of about one-half of the radial depth of the buckets a horizontal plane, and thence to the back of the buckets an inverted conic frustrum of about 45°," without any intervening curve, made a very great disturbance in the flow of the water in and through the wheel, and was otherwise so improperly constructed and proportioned that it is inoperative as a turbine. The only wheel ever built under this patent by the inventor wouldn't work, and proved an entire failure, and was abandoned by him, and what he describes and claims in his patent is impossible and absurd. I have mentioned many of the differences between my patented turbine and the wheels named in the question, but perhaps not all of them.

Int. 128. Please state whether a person skilled in constructing water wheels would be able, from your reissued patent, to construct a water wheel having the elements and producing the effect stated and described in the fifth claim of the reissue.

Ans. Yes.

Int. 129. Please refer to your answer to the one hundred and seventeenth interrogatory, and state whether, in your inteview with Munn & Co. there referred to, they indicated to you any reason for the defects in your original letters patent. If yea, state the same.

Ans. In my interview with Mr. Munn he informed me that he knew nothing of the details of such matters, and referred me to his examiner, as he called him, and asking me to explain fully and carefully the whole matter, and he would tell me just what could be done. I consulted
227 with his examiner and found from his conversation that he had no clear idea upon such matters in general, as to the principles of turbines, and much less the principles of my invention. I found it difficult to impress upon his mind clear ideas, and he could only express himself in this way: That whatever defects there were in the specification could be all legally and lawfully corrected at any time.

Int. 130. Did you know of a wheel made by said Whitney, and first

put in a factory in West Chelmsford in 1863? If yea, state fully your knowledge of that wheel, and how acquired.

Ans. I did know of such a wheel. I saw the wheel there and made measurements of it. I found it four feet in external diameter of wheel, twenty-two inches on the outer and top edge of the bucket to the bottom of the band surrounding the bottom portions of the buckets. It had a curved crown, conical centre and inner cylindrical and vertical wall, twenty-two and one-half inches in diameter at the lower and inner edges of the buckets; and was constructed substantially in every particular like the Hartshorne wheel, complainant's Exhibit T.

Int. 131. State if you know whether this wheel was made by said Whitney and sent to West Chelmsford at that time, namely, 1863?

Ans. It was.

Int. 132. Have you ever known of the Whitney wheel—either such as complainant's Exhibit T, or such as illustrated by complainant's Exhibit X—having been tested as to their efficiency and capacity?

Ans. I have.

Int. 133. Did the wheel, like complainant's Exhibit T, which you saw tested, show greater or less capacity and efficiency than a properly constructed Jonval turbine wheel of the same diameter.

Ans. It showed even less capacity and efficiency than a poorly constructed Jonval wheel.

Int. 134. Have you examined the Stowe wheel, Defendant's Exhibit No. 1? And, if yea, state whether it is substantially like your patented wheel; and, if not, state wherein any substantial difference exists.

Ans. I have examined it. It has substantially the same elements.

Adjourned.

228 BOSTON, *Nov.* 15, 1875.

Int. 135. Referring again to the language of your original patent, to wit, "when J is lowered, the water strikes the floats with all force and velocity due to its head directly under the rim of the wheel, which is so curved as to force the water down rapidly on the lower curved portions or bottoms of the floats"; is it possible for the water to be so forced down by the rim (or crown) of any wheel ever made by you or your assignees, or by any wheel constructed exactly like your Patent Office model, or as shown in the drawings of your original or reissued patent?

Ans. The water would not in the least be forced down on to the lower parts or bottoms of the floats by the curving of the crown. Any change in any portion of the water while within the bucket caused by the curving of the crown, even when as much curved as the Patent Office models and drawings show (and none of my wheels were ever made with the crown so much curved down), would be very slight; making no difference in the character of the wheel whatever, whether the crown was curved or perfectly horiztonal, and no practicable or perceptible difference in the operation or effect of the wheel other than as before stated by me in a previous answer.

Int. 136. Would the water be retarded by such a curved crown as shown in your Patent Office model and drawings any more than by horizontal crowns?

Ans. It would not. The curve or angle of the water passing under this crown, when the wheel is in motion, is much less and longer than shown by this crown in a radial, vertical plane.

Int. 137. Prior to making your first six-inch wheel, Exhibit I, did you construct any machinery expressly to do any part of the work of said

wheel on? If yea, what machinery, and how long were you engaged in making it, and during what time?

Ans. I did construct a foot-lathe and drill for this purpose. I took such of my time evenings as I could spare to do it in. I do not remember how long I was about it. It would take one some time to fit it up, even if he devoted all his attention to it, day and evening. Portions of both 1856 and 1857 were spent in making the lathe and such fixtures as became necessary as the work progressed.

Int. 138. Who made your Patent Office drawings?

229 Ans. Munn & Co.

Int. 139. Did you see them before they were sent to the Patent Office?

Ans. I did not. I only saw a copy of them when I got my patent.

Int. 140. Did you ever see the original drawings?

Ans. I have not.

Adjourned.

BOSTON, *Nov.* 19, 1875.

Int. 141. What would be the gross power of a seven-foot turbine wheel, made in accordance with your patent, under a twelve-foot head?

Ans. 303 horse-power.

Int. 142. What would be the gross power of a two-foot turbine wheel, made in accordance with your patent, under an eleven-foot head?

Ans. 20⅓ horse-power,

Int. 143. What would be the gross power of a two-foot turbine wheel, made in accordance with your patent under a ten-foot head?

Ans. 17½ horse-power.

Int. 144. Do you know the kind of water wheels which the aforesaid Waldo Whitney made, onward from the time of the making of the Hartshorne wheel, so called, being Complainant's Exhibit T? If yea, describe the same.

Ans. I have seen quite a number of them, all made substantially like the exhibit, up to the time he began to infringe my patent, in 1872 or 1873.

Int. 145. In a former answer you had stated that your wheel had been tested: please state whether at any testing of your wheel referred to by you in this deposition said Whitney was present, and if he was, state the time and place as accurately as you can.

Ans. There were two advertised public tests of my patented wheel; the first June 16, 1869, and the second June 26 (the 26th, I think), in 1869, at one of which I think Mr. Whitney was present, in Lowell, Mass.

230 Int. 146. Are you acquainted with the handwriting of said Waldo Whitney?

Ans. I am.

Int. 147. Please examine the name "Waldo Whitney," appearing at the end of the paper now shown you, now introduced, and to be marked Complainant's Exhibit C', J. G. S., Examiner, and state whether that name, in your opinion, is in his handwriting.

Ans. I should say it was.

Ints. 16, 17, 18, 19, 63, 64, 65, 76, 77, 95, 102, 112, 114, 116, 118, 119, 120, 129, 135, and 136 were seasonably objected to by counsel for defendant as incompetent.

Cross-examination by C. E. MITCHELL, Esq., of counsel for defendant:

Cross-int. 148. I understand from your answer to the ninth interrogatory that the first wheel made by you in June, 1855, was a centre vent wheel. Am I right?

Ans. It was so.

Cross-int. 149. And that you found, in July of the same year, that a centre vent wheel, "with guides somewhat in reverse of the Fourneyron," was then in use at the Boott Cotton Mills in Lowell. Am I right?

Ans. You are.

Cross-int. 150. And that the next wheel which you made was the six-inch wheel, Complainant's Exhibit I, which you say, in answer to Int. 10, you "completed and experimented upon in the summer of 1858." Am I right?

Ans. You are.

Cross-int. 151. And that the first wheel actually made for use in a mill was completed, set up and set to work in the month of December, 1858, for Isaac Austin, of Lowell. Am I right?

Ans. You are.

Cross-int. 152. You say, in answer to Int. 13, that the 1858 six inch wheel, Exhibit I, is not (except as it has recently been altered) in the shape in which you first made it; but that you cut away the floats in the way in which they are now seen in the exhibit. When you came to make your next wheel, to wit, the Austin wheel, Exhibit R,
231 which of the two forms of construction did you adopt for the bottom portions of the floats, the "cut-away" form or the form having the lower edges substantially on a radius?

Ans. It is nearer like the "cut-away" form.

Cross-int. 153. Is not the Austin wheel in fact and in principle the "cut-away" form, so far as floats are concerned?

Ans. So far as it relates to their bottoms.

Cross-int. 154. Certainly. Now, please look at Complainant's Exhibit J, to wit, the letter to Lovett, dated June 28, 1857, and point out the language which describes the construction of your wheel, if any such description of such construction is contained in said paper; and please to note that I ask for such description, if any there be, as would enable the person who received the letter, or any other person reading it, to make the wheel from the description.

Ans. There is no such description as the question calls for.

Cross-int. 155. Please look again at the letter of June 28, 1857, and see if you find the following language: "I think if the upper or lower disks plates are of proper form, thus . . . and the guides direct the water at not more than 15° to 18° from a tangent, combined with a proper bucket, will be as good a wheel as can be got up for the money." (I do not mean that the underscoring is in the original.)

Ans. I do find such language.

Cross-int. 156. Is it not true, then, that this letter of June 28, 1857, does not contain a description of any particular form of wheel or bucket, but does contain a discussion of the proper method of constructing guides for use in conducting water on to wheels?

Ans. The letter does not contain a description of the wheel, but refers to one as the wheel "which I proposed to build," the "proper" form of which had been fully discussed before the person to whom this letter was addressed went from Lowell; the disks are merely referred to as

to their form, to make more clear what had not been previously so fully discussed as had the form of the bucket.

Cross-int. 157. The letter plainly implies previous conversation or communication between yourself and the person to whom it is addressed, as to some portion of its contents; but I notice that when it comes to speak of buckets, it does not refer to a previous description, either expressed or implied; but in speaking of buckets says, not "the bucket which I described to you," or anything equivalent thereto, but uses this language: "combined with a proper bucket." The letter, I take it, has not been altered in this respect, has it?

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(Objected to as containing, the first part of it, an erroneous construction, or statement, touching what the letter means or implies.

Ans. No, sir.

Cross-int. 158. In this letter, did you enclose a copy of drawing of speed regulator, with request that Lovett should put his name on the drawing, and also the date; and if so, why did you make such request?

Ans. I did enclose such drawing; I don't recollect what the special reasons were.

Cross-int. 159. Have you any doubt that it was for the purpose of affording proof bearing upon the date of your production of such speed regulator?

Ans. In reference to the date and name I have no doubt about it.

Cross-int. 160. Does your letter of March 30, 1858, contain any description of the floats of the wheel, except by reference to the drawings enclosed therein? I refer to Exhibit K.

Ans. I observe none.

Adjourned.

BOSTON, *Nov.* 20, 1875.

Cross-int. 161. In a centre vent wheel I believe the ring which holds together the lower portions of the floats is underneath their lower edges, is it not?

Ans. It is.

Cross-int. 162. Please look at Complainant's Exhibit M, said to be one of the drawings enclosed in the letter of March 30, 1858, and state if the ring is not substantially underneath the floats.

Ans. What little ring there is is underneath the floats at their outer and lower edges.

Cross-int. 163. Is there anything in the shading of the floats which gives any indication of their form?

233

Ans. There is not.

Cross-int. 164. Now, will you look and see if you find in your letter of March 30, 1858, this language, "The wheel W is every way the same as the wheel in No. 1"?

Ans. I do.

Cross-int. 165. To what does "the wheel in No. 1" refer?

Ans. It refers to the drawing Sheet No. 1, Complainant's Exhibit L.

Cross-int. 166. Please look at the upper drawing of said last-named exhibit, and state how you would have altered the same if you had wanted to exhibit therein the buckets of a centre-vent wheel; or, in other words, do not the curved dotted lines of said upper drawing curve precisely as they would curve in a drawing of a centre-vent wheel, and is there not an entire absence of dotted lines to represent the discharge edges of floats having their lower discharge edges on a radial line?

Ans. The upper drawing represents the centre-vent part of the bucket, immediately under the crown and as far down as the inner edge extends

in a vertical line. There is no line to represent the lower discharge edge of the floats.

Cross-int. 167. Then, if I understand you, there is nothing in said drawing which of itself speaks any language upon the question whether it represents a centre-vent wheel or otherwise. Am I right?

Ans. You are, as to the upper drawing.

Cross-int. 168. Is there anything in the shading of the buckets of the lower drawing of said Exhibit L which throws light upon the form of the bucket?

Ans. There is not.

Cross-int. 169. I notice that the form of the ring round the lower edges of the buckets of said lower drawing is somewhat different from the form of the ring in the other drawing which you enclosed in the same letter, which ring you said was underneath the floats. Am I right in understanding you to have said in said letter that the wheel W of Exhibit M is every way the same as in wheel No. 1 (meaning Exhibit L)?

234 Ans. I used such language, referring to the wheels in said exhibits.

Cross-int. 170. Two wheels which have structural differences cannot be every way the same as each other, unless they have the same mode of operation, can they?

Ans. Certainly not.

Cross-int. 171. Would any portion of the water passing through the wheel shown in Complainant's Exhibit M have a vertical line of movement in passing through the float?

Ans. Not if the band remained precisely as represented in the exhibit.

Cross int. 172. Do you mean by the last answer yes or no?

Ans. No.

Cross-int. 173. Would not all the water passing through said floats pass through in diagonal lines, between a horizontal direction and a vertical direction, there being no lines of direction, either substantially horizontal or substantially vertical; I mean the precise floats represented in said drawing?

Ans. None of the lines would be exactly horizontal, exactly vertical, or exactly diagonal.

(Answer objected to as not responsive.)

Cross-int. 174. Please answer the question, with the explanation that the question calls for the substantial directions of the lines of motion of the water in passing through the floats, and not for their exact direction.

Ans. The upper portion would be substantially horizontal, the lower portion diagonally.

Cross-int. 175. Please look at Complainant's Exhibit N, from which the drawings referred to in the last question were taken (as you have stated in your direct testimony), and state if you know who made the light pencil marks passing through the space occupied by the floats, and when made and what they represent.

Ans. I may have made those lines or I may not. I have no distinct recollection whether I did or not—certainly none when they were made nor for what particular purpose.

Cross-int. 176. How long have they been there, so far as you know?

235 Ans. They have been out of my possession about three years,

and I have no doubt they were on there at the time they went out ;I think they were.

Cross-int. 177. How much longer have you no doubt they were on there?

Ans. I don't know anything about that.

Cross-int. 178. Have you any substantial doubt you put them on yourself?

Ans. No; I have not.

Cross-int. 179. Have you any substantial doubt that they were placed upon the drawing to show the course of the water?

Ans. Partly that.

Cross-int. 180. Do they, to wit, said light lines, show with substantial correctness the lines of movement of the water in passing through the floats?

Ans. They do so, somewhat roughly.

Cross-int. 181. Which of said lines on said drawing is substantially horizontal?

Ans. The one nearest the crown.

Cross-int. 182. How many degrees of downward inclination can a line have, to be, in your judgment, substantially horizontal?

Ans. It might be eight or ten at the end.

Cross-int, 183. At what degree, in your judgment, does a downward inclined line become substantially other than a horizontal line?

Ans. When more than half of its length is inclined the eight or ten degrees.

Cross-int. 184. Suppose a straight line drawn from the upper outer edge of the bucket of the wheel of Exhibit N to the upper inner edge of said bucket, how many degrees would such line deviate from a horizontal line?

Ans. About twenty degrees.

Cross-int. 185. And I understand from your answers to cross-ints. 182 and 183 that a line having a downward inclination of about twenty degrees is not substantially horizontal, but does substantially incline downward from a horizontal direction. Am I right?

236 Ans. You are, as to the latter part of the question.

Cross-int. 186. What gives the upper lamina of water entering the wheel such a course that the upper surface of such upper lamina leaves the bucket twenty degrees farther downward from a horizontal line than the point of its entry into the bucket?

(Objected to as hypothetical, as not designating any particular wheel or bucket, and as assuming as a fact what has neither been proved nor admitted.)

Ans. The form of the crown of course prevents the water leaving it at a higher point.

Cross-int. 187. Do you mean by your last answer that the form of the crown forces the water down to the horizontal elevation referred to in the last question?

Ans. Well, I don't mean there is any forcing about it.

Cross-int. 188. Would the upper edge of the upper lamina of water entering the wheel horizontally, as it does, descend twenty degrees in passing through the float if it were not forced down by the form of the crown; or, in other words, can the form of the crown prevent the water leaving the float at a higher point, as stated in your answer to cross-int. 186, without the exercise of force?

(Same objection as to cross-int. 186.)

Ans. As to the first part of the question, the natural direction of the

water is downward; the lamina could not leave at a higher point without force, as to the latter part of the question.

Cross-int. 189. Witness is requested to answer the last half of the last question directly, to wit, "Can the form of the crown prevent the water leaving the float at a higher point, as stated in your answer to cross-int. 186, without the exercise of force?"

Ans. Of course it does prevent it.

Cross-int. 190. Does it "prevent it" without the "exercise of force"?

Ans. The lamina referred to could not certainly leave at a higher point without forcing the crown of the wheel upward; but I do not look upon this fact as implying that the water is forced down by the crown.

237 Cross-int. 191. Is it, in your judgment, an incorrect form of expression to say that the water, not being able to force the curved crown upward, is by such crown forced down?

Ans. In this case I think it is incorrect.

Cross-int. 192. Is it incorrect to say that the water is caused to go down by the form of the crown?

Ans. Yes, it is, primarily.

Cross-int. 193. Does water which enters the wheel with a horizontal impulse and power that would raise the crown by its action upon its curved under surface, if the crown were not in a fixed condition vertically, descend rapidly from such horizontal direction, when such crown is fixed, without a cause? And, if not, will you please state what is, in the case of the wheel under consideration, to wit, the wheel shown in Exhibit N, the cause of the descent of the upper surface of the upper lamina of water twenty degrees in passing through the float?

Ans. It does not. It is due to the fact that the water, in passing from the wheel through a horizontal plane at the bottom of the wheel, must necessarily be in a vertical direction; and the water naturally seeks this direction as soon as it enters the wheel.

Cross-int. 194. Do you mean to swear that "water which enters the wheel with a horizontal impulse and power that would raise the crown by its action upon its curved under surface if the crown were not in a fixed condition vertically," naturally seeks a vertical direction as soon as it enters the wheel, without the exercise of either force, cause, action, or influence of the curved under surface of such crown, when such crown, being fixed, cannot be lifted by the water? And please answer the question categorically.

Ans. I do; if I understand the question.

Cross-int. 195. Would the upper edge of the upper lamina of water "descend naturally" in the case supposed in the last two questions if the crown were horizontal, perfectly, on its under surface?

Ans. The crown has nothing to do whatever with this natural downward tendency.

Cross-int. 196. (Question repeated, and the witness requested to answer yes or no.)

238 (Counsel for complainants objects to having the witness required to answer yes or no, as the witness should be left at liberty to make such full answer as would express his knowledge and opinion.)

Ans. No.

Cross-int. 197. Then if, in the case supposed, the water would not descend under a horizontal crown, and would descend under a crown inclined downward twenty degrees like the crown in Exhibit N, it is the differ

ence in the shape of the crowns that produces the difference in the effect is it not?

Ans. It is what permits a difference.

Cross-int. 198. Does not the difference in the shape of the crowns produce the difference in the effect—that is, produce the difference?

Ans. Yes, substantially.

Cross-int. 199. Does the crown in Exhibit H differ, so far as the degree of its descent within the limits of the floats is concerned, from Exhibit N?

Ans. I suppose not.

Cross-int. 200. I suppose, then, that according to your definition of what constitutes horizontality, contained in your answers to Cross-ints. 182 and 183, that a lamina of water passing inward under such crown would not pass substantially horizontally through the float, would it?

Ans. Not if it passed directly from the outside on a radial line on the angle indicated. It does not pass through the wheel in that way; it moves with the wheel's motion, partly rotary and partly radial motion.

Cross-int. 201. So far as it moves with the wheel's motion, does it impart power to the wheel?

Ans. Yes.

Cross-int. 202. Does the path of the water through the wheel, in a line partly rotary and partly radial, affect the fact that in going from the periphery of the wheel to the inner edge of the buckets it passes downward a distance equal to the difference between the height of the outer edge of the buckets and the height of the inner edge of the buckets?

Ans. It does not; but does affect the angle of the path.

239 Cross-int. 203. How much difference would there be between the line of direction of the lamina of water which passes through the float of the wheel of Exhibit M most nearly horizontally and the line of direction of the lamina passing through such float most nearly vertically? I mean comparing the lines of direction of such laminæ while within the limits of the floats.

Ans. It would require complicated and tedious calculation to show the exact difference, with exact data or measurements as a basis of the calculation.

Cross-int. 204. Would not the upper edge of the upper lamina and the lower edge of the lower lamina have the same general course within the limits of the buckets?

Ans. If on the radial plane of the drawing, yes. If on the lines of the actual path of the water, no.

Cross-int. 205. How much difference would be made by the fact that both laminæ travel in paths not in a radial plane? Would it be substantial?

Ans. I should think it would.

Cross-int. 206. Is the difference so slight that you can't tell whether it is substantial or not?

Ans. No; it is not.

Adjourned.

BOSTON, *Dec.* 9, 1875.

Cross-int. 207. Does not the water leave the floats in what has been called a radial plane?

Ans. I think it does.

Cross-int. 208. Then, so far as the direction of the water on leaving the floats is concerned, it is determined by the curves of crown and ring

as seen in the vertical cross section, or a cross-section coincident with the radial plane spoken of, is it not?

Ans. The continuation of the curve of the crown, together with the form of the floats at the point of leaving (of the upper lamina), would determine the radial direction of the water at that point. In the case of the ring, the form of the float and the natural tendency of the water would determine chiefly the direction of the water at the point of leaving, with but little regard to the form of the ring within the bounds of the floats.

240 Cross-int. 209. Do you mean by your last answer that the course of the water on leaving the floats is not determined by the shape of the crown, as seen in vertical cross-section, coincident with a radial plane, it having been already stated by you that the water leaves the floats in a radial plane?

Ans. I do not mean that the water would not follow the crown; it would do so whatever its form, unless the water were passing this point of the crown at a velocity greater than that due to atmospheric pressure, thus forming a vacuum, which could not be the case unless the wheel in question was operating under more than two hundred feet pressure of water; and if the crown in question curved upward, or were even horrizontal, the water would still follow the crown, and the upper lamina would become distorted, and move slower than that below, and the effect would be detrimental to the efficiency of the wheel.

Cross-int. 210. Have you noticed the words "cross-section" and "coincident with a radial plane" in my last questions?

Ans. I have.

Cross-int. 211. Well, do you mean by your last answer, or your preceding answer, that the water leaving the floats would take a course underneath the crown indicated by the shape of such crown as seen in such cross-section, or do you not?

Ans. I mean the water will conform to the shape of the crown as shown on the plane of the drawing referred to.

Cross-int. 212. I suppose so; now will you give the extreme vertical height of float in the thirty-inch Austin wheel, complainant's Exhibit R, referred to in answers to Ints. 44 and 45?

Ans. Five and three-quarters inches.

Cross-int. 213. Are the two next wheels, I mean the forty-two inch wheel and the seventy-two inch wheel, mentioned in your answer to Int. 45, the wheels described in complainant's Exhibits P and Q, respectively?

Ans. They are.

Cross int. 214. Is the twenty-one and one-quarter inch wheel referred to in the same answer described in any of these exhibits, do you know?

241 Ans. There is no reference to that individual wheel, so far as I know.

Cross-int. 215. What is the vertical height of float in the six-inch Swain wheel, complainant's Exhibit F?

Ans. Two and one-tenth inches, nearly.

Cross-int. 216. Do you mean by "nearly" that it is less or more?

Ans. I mean that that is within two or three hundredths.

Cross-int. 217. What is the vertical height of the double float in the six-inch Leffel turbine, shown on complainant's Exhibit V?

Ans. It appears to be two and fifteen one-hundredths inches, very nearly.

Cross-int. 218. Of all the wheels in this case, I understand that the

thirty-inch Austin wheel, with its five and three quarters inch float, is the only working wheel that antedated your patent; am I right?

Ans. You are not.

Cross-int. 219. It is the only wheel mentioned by you as tested, is it not? I refer to your answer to Int. 46.

Ans. It is.

Cross-int. 220. What is the vertical height of float in the alleged infringing wheel, complainant's Exhibit D?

Ans. Eleven and three-eighths inches.

Cross-int. 221. How long have you been acquainted with the class of wheels known as "spoon wheels"?

Ans. Ever since I can remember anything almost.

Cross-int. 222. Now state generally how long that would be.

Ans. At least thirty years.

Cross-int. 223. Could not a wheel be made which would come within the principle of your reissued patent which would not utilize more than 33 per cent. of the power of the water that passed through it?

Ans. I suppose so, in some respects.

Cross-int. 224. Does not the question admit of an answer yes or no?

Ans. Yes.

Cross-int. 225. And is the answer yes, the proper one?

242 Ans. Yes.

Cross-int. 226. If all the Jonval portion of the floats in complainant's Exhibit T were removed, and the wheel were replaced in its case in all respects as before, would not the wheel rotate on its vertical axis?

Ans. With sufficient water applied, yes.

Cross-int. 227. It would not be a Jonval wheel under such circumstances, would it?

Ans. So far as the walls of the wheel and the discharge are concerned it would be the same. The effective part of the float being taken away would entirely destroy its efficiency as a Jonval wheel.

Cross-int. 228. Is there in said wheel, that is, complainant's Exhibit T, any obstruction within the plane of the lower edge of the band to the discharge of water of such wheel, excepting the small shaft or hub?

Ans. There is not.

Cross-int. 229. What is the best percentage obtained by the Jonval wheel?

Ans. I have heard of as high as 87 per cent.

Cross-int. 230. What is the best percentage obtained by the Fourneyron wheel?

Ans. 88 per cent.

Cross-int. 231. What is the best percentage of the centre-vent wheel?

Ans. 83 per cent., the nearest I recollect.

Cross-int. 232. Had centre-vent wheels been made prior to your invention, which utilized all the space between the inner edges of the lower rim for discharge; or, in other words, in which the discharging water filled the discharge area?

Ans. Yes.

Cross-int. 233. What were the relative proportions of the Howd centre-vent turbine, mentioned by you in your answer to Int. 89, as usually made; say, a six-foot wheel?

Ans. If the relative measurements are meant, I have no means of giving them just at this time.

Cross-int. 234. Can you not give them substantially?

Ans. It would be merely guessing at it. I should say about twelv

243 inches deep from top to bottom, though I think less than that. The rims or crowns, I should say, were about ten inches wide.

Cross-int. 235. What do you mean by height?

Ans. I mean the vertical distance between the upper and lower crowns, to which the floats are fastened at top and bottom.

Cross-int. 236. And the floats, if I am right, extended all the way from one crown to the other.

Ans. Yes.

Cross-int. 237. In answer to Int. 97, you speak of the upper and lower crowns of a Boyden centre-vent wheel as being curved downward; now, did not the upper crown of the Boyden centre-vent curve upward instead of downward, within the limits of the floats? I refer to the wheel described as tested in the work called "Lowell Hydraulic Experiments."

Ans. The question refers to two distinct wheels. The Boyden centre-vent referred to in my ninety-seventh answer had both crowns curved down, as there stated. The one described by Mr. Francis, in his work entitled "Lowell Hydraulic Experiments" was of his own design, and is referred to in the same answer as the Francis centre-vent.

Cross-int. 238. You speak in reply to Int. 89, of the "Boott centre-vent wheels designed by Mr. Francis, of Lowell," of which you say there are drawings in the "Lowell Hydraulic Experiments"; were they what you now refer to as the Boyden centre-vent?

Ans. They were not.

Cross-int. 239. Is there any description in the "Lowell Experiments" of centre-vent wheels, or drawings of centre-vent wheels, excepting those in which the upper and lower crowns are horizontal and parallel, or those in which the upper crown curves upward within the limits of the floats?

Ans. I recollect none.

Cross-int. 240. Is there not in such work a description and drawing of the Boyden centre-vent turbine?

Ans. There is none other than what is called the Boott centre-vent, having curved crowns, and which he refers to (if my memory serves me correctly) as constructed "from designs of the author."

Cross-int. 241. Does the Boott centre-vent curve upward or
244 downward within the limits of the floats, as shown in the drawing, or is the upper crown horizontal?

Ans. The crown is a curved one, the outer half being lower in the middle of its width than at the outer edge; from the middle inward it curves upward, the under face of the crown being the segment of a circle on a radial line, the convex side down.

Cross-int. 242. And the upper stratum of water shot upwardly instead of downwardly, as it left the inner edge of the float, did it not?

Ans. Its motion was certainly upward, if on a radial plane.

Cross-int. 243. If it was not on a radial plane was it not upward?

Ans. Certainly; it will follow the crown, whatever its form, with the exceptions I have made in a former answer.

Cross-int. 244. What "exceptions," do you refer to in said drawing of said centre-vent wheel, in said Lowell experiments, "made in a former answer"?

(Objected to as misstating the witness's last answer.)

Ans. I refer to those in regard to the shooting of the water with a pressure greater than atmospheric pressure, and by which I mean in this case that the current of the water next the upper crown, after passing the middle of its width, becomes unnecessarily distorted and

checked in its flow, and there would be a shock somewhat analogous, and the effect would be somewhat analagous to the effect upon an individual, were he, in running for his life, to step suddenly, and without previous discovery, into a hollow in the ground over which he was running; he would feel the sense of the shock through his whole system, and even if the depression were but slight, if it were unexpected, he, of course, would be impeded, and he would be obliged to slack his speed and collect his energies practically for a new start. The current of water flowing into this upward curve would be materially checked in its velocity, and would actually roll and tumble, and, as I have before said, be distorted in its current, and has got to gather to make a new start to get away from the wheel. In other words—

(Counsel for defendant here interrupts to explain that his whole line of inquiry relates to the description of certain drawings in
245 the work called "Lowell Experiments," and not to the value of any wheels whatever.)

Witness continues: Were this crown a continuous concave curve on its under surface, similar to the one referred to as the Boyden centre-vent in answer to 89 of the direct, the flow of the water would have been more uniform as a whole and in detail, and would have escaped through the horizontal plane of the bottom of the wheel, with an expenditure of less of its total impelling force; and there would have been, in consequence, a larger percentage of its force or power transmitted as useful effect.

(Objected to as irresponsive.)

Cross-int. 245. Am I right in assuming in your answer to question 89 that you never saw one of "Mr. Boyden's patent centre-vent wheels," of which you say you read a description in the "Patent Office Reports" of 1853?

Ans. You are not.

Cross-int. 246. In any of the centre-vents known to you prior to the date of your invention, was there any crown so shaped as to force the water down rapidly upon the lower curved parts of the floats?

Ans. There were none to my knowledge.

Cross-int. 247. Then there were no different shapes of crowns which were equivalents for that purpose, were there?

Ans. I knew none of that character.

Cross-int. 248. Did the Dripps patent, referred to by you in answer to the one hundredth interrogatory, have a band encircling the lower edges of the floats?

Ans. I am unable to tell.

Cross-int. 249 (de bene esse). You say, in reply to int. 111, that you sent to Munn & Co. "a writing of what you thought was new in it"; was that writing substantially the same as the enumeration of advantages contained in your original patent just before the claims?

Ans. In so far as the particulars mentioned are concerned it probably is substantially so.

Cross-int. 250 (de bene esse). My question intended to ask if the
246 two were not substantially the same as to all the particulars enumerated by you in the writing referred to as sent to Munn & Co., and which you represented to them to be new. With this explanation, please answer.

Ans. I think it was not.

Cross-int. 251 (de bene esse). Can you swear it was not?

Ans. Yes.

Cross-int. 252 (de bene esse). What other things can you swear was particularized by you in said letter, as an advantage invented by you?

Ans. The form and construction of the floats.

Cross-int. 253 (de bene esse). Do you know why they omitted to speak of them as advantages?

Ans. No, I do not.

Cross-int. 254 (de bene esse). Will you swear that the enumeration of advantages in the original letters patent is not substantially taken from the writing which you sent?

Ans. To the best of my knowledge and belief they are not substantially the same; they certainly do not accord with what I always thought I had invented.

Cross-int. 255. Did you ever see the Temple wheel?

Ans. I have seen one so called in this case as defendant's exhibit.

Cross-int. 256. Is that the only one you ever saw?

Ans. It is the only one of that character, except I may have seen the Patent Office model of which this claims to be the duplicate.

Cross-int. 257. You say in answer to int. 127 that "the only wheel ever built under this patent by the inventor" (referring to the Temple patent) "wouldn't work and proved an entire failure and was abandoned by him"; what personal knowledge have you on that subject?

Ans. I learned it from the statement of the inventor himself.

Cross int. 258. Did the inventor tell you so?

Ans. No, he did not.

Cross-int. 259. How do you know he told anybody so?

Ans. I saw a writing with his name attached—under oath.

Cross-int. 260. Do you know it was his name attached to it?

Ans. I cannot swear to his writing, but it was in the usual form
247 of a deposition, with a certificate of a notary public with seals, and the fact, as stated, that said Temple had appeared——

(Counsel for defendant here interrupts; objects to the witness stating matters not within his personal knowledge.)

Witness continues: And made oath to the deposition referred to. I am not quite sure about the title of the officer, whether a notary public or other proper officer.

Cross-int. 261. I understand you to say substantially you have no personal knowledge on the subject. Am I right?

Ans. Yes; if you mean personal observation.

Cross-int. 262. Where did you see a Whitney wheel like complainant's Exhibit T tested?

Ans. In Lowell, Mass.

Cross-int. 263. Was Mr. Whitney present?

Ans. I think he was.

Cross-int. 264. When was it?

Ans. In 1870, I think.

Cross-int. 265. What was the diameter of the wheel?

Ans. Thirty inches, if I recollect.

Cross int. 266. Under what head of water used?

Ans. I could not give from memory.

Cross int. 267. Give as nearly as you can.

Ans. Fifteen or sixteen feet.

Cross-int. 268. How many horse power did the test show the wheel to have under that head?

Ans. Twenty-two, I think; I have seen several of them tested, but not all giving the same power.

Cross-int. 269. How many horse power would a Jonval wheel exactly

like complainant's Exhibit H in shape and proportions, and thirty inches in diameter, give under the same head?

Ans. I couldn't tell without reference to memoranda, or to some of the exhibits. Having referred to Exhibit P, I answer, about twenty-one horse power on fifteen foot fall; twenty-three on sixteen foot fall.

Cross-int. 270. You speak of several tests of the Whitney wheel in answering 268; did the one you have now referred to give the best result for the Whitney wheel, or did some one of them give
248 a better result than twenty-two horse power under a fifteen or sixteen foot fall for a thirty-inch wheel?

Ans. They have been as high as twenty-seven horse power on sixteen foot fall.

Cross-int. 271. Then, did not the wheel giving twenty-seven horse power under a sixteen-foot fall show as great capacity as a Jonval wheel like Exhibit H of the same diameter, which gives twenty-three horse power under a sixteen-foot fall.

Ans. It did in that instance.

Cross-int. 272. I understand Exhibit H to be placed in evidence as a Jonval wheel of proper construction and proportions to give the best results for a Jonval wheel; am I right?

Ans. I don't understand it exactly in that way, but as showing the proportions according to the best authorities.

Adjourned.

BOSTON, *Dec.* 10, 1875.

Cross-int. 273. How many horse power did your tested thirty-inch Austin wheel give under fifteen feet head, if your test enables you to answer the question exactly or approximately?

Ans. The Austin wheel was tested when submerged six and a half feet in back water, leaving the effective head three and a half feet. The surplus power, besides driving the suitable pair of gears and a three-inch shaft twenty-two feet long with suitable bearings and pulleys, two and three-fourths horse power.

Cross-int. 274. Is that as closely as you can approximate in answer to the question?

Ans. I made no other test than the foregoing at full gauge.

Cross-int. 275. In your answer to int. 18 you say, among other things, that you explained to Lovett "the form that I proposed for the floats as best adapted to receive the impulse of the water to take from it its power or force at both full or partial gate opening," etc. Did your original patent contain claims relating to your method of securing both full and partial gate openings?

Ans. I supposed at the time that it did.

Cross-int. 276. What is the fact about it now?

Ans. There were claims relating to those improvements.

249 Cross-int. 277. Was the improvement a valuable one?

Ans. I have always thought so.

Cross-int. 278. This improvement consisted, in general terms, in letting the water into the wheel from the tops of the chutes, and in increasing the size of the orifices by lowering the gate in a downward direction according to the quantity of water used, did it not?

(Objected to as improper in cross-examination, and as assuming what has not been proved or admitted.)

Ans. I can't answer the question by yes or no, but in conformity to the truth.

Cross-int. 279. Well, will you answer it in some other way, then?

(Objected to as before.)

Ans. This arrangement of opening downward was only one of the important parts of the improvements explained to said Lovett; another essential part being in combining the effective elements of inward flow and downward flow turbines in the same wheel.

(Answer objected to as irresponsive.)

Cross-int. 280. The question related to the method of opening the gates or gate that admitted the water to the wheel; and I assume from a portion of your preceding answer that my general statement of your way of doing it, contained in cross-question 278, was substantially correct; am I right?

(Objected to as before.)

Ans. Yes, if I comprehend the question.

Cross-int. 281. And you explained such way of producing such "full and part gate opening" to said Lovett at the time stated by you in your answer to ints. 17 and 18, did you?

Ans. I think I did.

Cross-int. 282. Did the various centre-vent wheels referred to by you in ints. 89 and 97 have substantially the same parts and proportions as the Howd or United States centre-vent wheel, with the exceptions of the shapes of the crowns of which you have spoken?

Ans. They all had substantially the same parts; their proportions were all different.

250 Cross-int. 283. What were the proportions of the "Blake," for instance, say for a six-foot wheel?

Ans. I have no data of that size.

Cross-int. 284. Give the proportions for any size.

Ans. In a five-foot Blake wheel the floats occupied a width radially of about fourteen inches, and a space between the crowns nineteen inches high on the outside and twenty-one inches high on the inside, leaving a space inside of the inner edge of the lower crown about thirty-two inches in diameter for the escape of the water from the wheel.

Cross-int. 285. Who made the "Warren wheel?"

Ans. Alonzo Warren.

Cross-int. 286. Was it invented or patented by him?

Ans. I think not.

Cross-int. 287. Do you know under what patent it was made, if any?

Ans. I do not.

Cross-int. 288. What was the form of its crown, and what the proportion of its parts?

Ans. The crowns were horizontal; and in a five-foot wheel the floats occupied a radial width of six one-eighth inches, and the space between the crowns occupied by them was about twelve inches high.

Cross-int. 289. Was there any difference in the height of the two edges of the floats; that is, between the height at which the water entered and the height at which it discharged?

Ans. I recollect none.

Cross-int. 290. What is your best recollection, that there was a difference or that there was not?

Ans. That there was not.

Cross-int. 291. Have you any doubt about it?

Ans. No.

Cross-int. 292. To what extent were the "Warren wheels" made, and were any other "Warren wheels" made, to your knowledge, than such as you have been describing?

Ans. I know of only seven personally, that I now recall, that were

introduced in the city of Lowell. I have seen large numbers of
251 statements, purporting to be recommendations of the "Warren wheel," by parties who had them in use. I have known of several modifications of the "Warren wheel" being since made by him and others.

Cross-int. 293. Then if you have known of but one "Warren wheel" and its modifications, I suppose that is the "Warren wheel" referred to in your reissued letters-patent, is it not?

Ans. Yes, I so understand it.

Cross-int. 294. Have you stated to any person that you were still the owner of the extension of your patent?

Ans. No.

Cross-int. 295. What percentage did a well constructed "Warren wheel" give?

Ans. I have no means of knowing at this moment.

Cross-int. 296. What is your best recollection upon the subject?

Ans. I think they were rated or estimated in Warren's pamphlet of particulars at seventy-five per cent.

Adjourned.

BOSTON, *Dec.* 11, 1875.

Direct examination resumed:

Int. 297. The lower or Jonval part of the buckets in the wheel marked Complainant's Exhibit R appears to be somewhat shorter proportionally than in the other exhibits; why was this?

Ans. The only reason that I know of was the difficulty in setting the cores which formed the floats (the wheel and floats being cast in a single piece), and the difficulty in the flowing of the iron from the top through these cores so as to fill the bottom of the mould which contained the Jonval part of the wheel. I remember that three or four attempts were made to cast the wheel before the exhibit referred to was obtained, and there was much delay from a lack of experience by the moulders in making such a wheel and in waiting for changes in the core pattern.

Int. 298. Have you known of any of your wheels having been made since that time by yourself, or by or for the assignee of your patent, having the floats of cast-iron, and cast at the same time with the other parts of the wheel proper?

252 Ans. I have; four others of the same size made during the following year, those being all that were ever made in that way by me or for my assignees.

Int. 299. Does Complainant's Exhibit P contain tables showing the power of your patented wheel of different sizes under different heads, for the quantity of water used, and giving the revolutions per minute?

Ans. It does.

Int. 300. Please refer to cross-ints. 221 and 222, and the answers to the same, and describe the wheels you there refer to called in cross-int. 221 "spoon wheels," and state how the water was applied to them.

Ans. They had a vertical shaft with any convenient number of arms fixed in it, on the outer extremities of which was usually fixed, though not always, a vertical cylindrical ring or band twelve or fifteen inches high. The floats were sometimes fixed to the inside, and sometimes to the outside, and sometimes to the arms only, when there was was no band. The floats were simply a piece of thick plank, scooped out a

little, set at an angle, and received the water from a single spout on the top.

Int. 301. Did you ever know or have information of any such shaped buckets in "spoon" or "spout" wheels as are shown in Defendant's Exhibits 2, 3, and 7; or in defendant's sketch marked "Exhibit Sketch of 1837 wheel"?

Ans. No.

Int. 302. Are the wheels described by you in your three hundredth answer similar to the wheel shown in Exhibit Sketch of 1837 wheel, in principle, character, operation and effect?

Ans. They are.

Int. 303. Please refer to the second paragraph in your sixty-eighth answer, commencing with "each particle of water," and to cross-int. and ans. 200, and state whether what you there say in regard to the path or direction of the water or lamina of water is based upon knowledge acquired from experiments made with your turbine wheel.

Ans. It is so based.

Int. 304. Did those experiments show that the water travels a
253 longer distance before leaving the buckets than is stated in the last paragraph of your sixty-eighth answer; and, if yea, how much longer?

Ans. They did; nearly one half of the circumference of the wheel.

Int. 305. Where are the letters which you received from John M. Lovett, and to which you refer in the first part of your letters to him, complainant's Exhibits J and K?

Ans. I don't know; I have made diligent search for them, but cannot find them.

Int. 306. Please refer to cross-ints. 223, 224, and 225, and state whether you ever knew or heard of any wheel being made which would come within the principle of your reissued patent, which would not utilize more than 33 per cent. of the power of the water that passed through it.

Ans. No.

Int. 307. Would a wheel such as supposed in cross-int. 226 utilize any power of the water applied?

Ans. Very little, indeed.

Int. 308. Please refer to your two hundred and forty-third answer, and state whether "the exceptions" there named refer to the exceptions in your two hundred and ninth answer.

Ans. They do.

Int. 309. Please refer to cross-ints. and ans. 229, 230, and 231, and state whether the several wheels there referred to would utilize any such percentage as there stated when doing their appropriate work, as usually placed and operated; and, if not, state what would be the fair average of percentage obtained from each kind of wheel referred to.

Ans. They would not; seventy-five per cent. for the Jonval wheel, seventy-eight per cent. for the Fourneyron, and seventy per cent. for the centre-vent.

Int. 310. In your two hundred and sixty-eighth and two hundred seventieth answers, you speak of the horse-power of a thirty-inch Whitney wheel under a fifteen and sixteen foot fall, as tested; what percentage of useful effect of the water used did these vessels give?

Ans. The twenty-two horse-power wheel gave sixty-six per
254 cent.; the twenty-seven horse-power wheel, according to the best of my recollection, gave sixty-two per cent.

By consent of counsel I desire to make the following statement:

In my ninety-seventh answer I state, "Of the Francis centre-vents, some had horizontal crowns at both top and bottom, some had both crowns curved, the inner and outer edges being nearly of the same height horizontally, but of a less height near the middle of their width, the surface of each being convex from their outer to their inner edges of their face side"; and also in answer to cross-int. 241, I use substantially the same language in describing said crown, and which, on reference to the work "Lowell Hydraulic Experiments," I find to be an error in that respect, confounding the description of that crown with that of the crowns of the Boyden-Fourneyron, illustrated and described in the same work. A correct description would be "Of the Francis centre-vents, some had horizontal crowns at both top and bottom; some had both crowns curved," the inner edge of the top one being higher than the outer edge, and the inner edge of the bottom one being lower than the outer edge, or "flaring towards the axis of the turbine."

ASA M. SWAIN.

Attest:

JOHN G. STETSON,
Examiner.

Deposition of John M. Lovett.

Direct examination by J. S. ABBOTT, Esq., of counsel for complainant.

BOSTON, *Dec.* 7, 1875.

Int. 1. What is your name, age, residence, and occupation?

Ans. John M. Lovett; fifty; Lowell, Mass.; pattern maker.

Int. 2. About how long have you resided in Lowell?

Ans. Two years; but substantially forty-eight years, except at short intervals.

Int. 3. When do you mean you resided two years in Lowell?

Ans. The last two years.

Int. 4. Did you ever reside in one of the Western States? If yea, in what State, and during what time?

255 Ans. I resided in Minnesota in the years 1857 and 1858, and part of 1859.

Int. 5. From what place did you go to Minnesota?

Ans. From Lowell, Mass.

Int. 6. About how long have you resided in Lowell, without interruption, before you left for Minnesota?

Ans. About ten years.

Int. 7. Were you acquainted with Asa M. Swain before you moved to Minnesota?

Ans. I was.

Int. 8. Intimately or slightly?

Ans. Rather say intimately than slightly.

Int. 9. In what was said Swain engaged for two or three years before you left for Minnesota, so far as you know?

Ans. Pattern making and mechanical work.

Int. 10. Were you acquainted at that time with water wheels to any extent?

Ans. To a considerable extent.

Int. 11. Did you at that time understand generally the characteristics of a centre-vent turbine and also of the Jonval turbine?

Ans. I did.

Int. 12. What, if anything, did you know before you moved to Minne-

sota as to said Swain's purpose to construct a water wheel? Did he make any communication to you as to the ideas or plans he had?

Ans. He did; he explained a wheel to me constructed substantially as he now builds them.

Int. 13. About how long before you moved to Minnesota did he explain or describe to you such wheels? Please state the time, according to your best recollection.

Ans. Not far from a year, according to my best recollection.

Int. 14. When did you move to Minnesota? State the month and year, if you can.

Ans. May, 1857.

256 Int. 15. Before you moved to Minnesota did you have more than one conversation with said Swain in which he explained the wheel he intended to make? Please state how often you conversed with him about it, whether frequently or otherwise.

Ans. I had many conversations with him, and often, on the subject of water wheels.

Int. 16. And on the subject of the wheel he was intending to make, and to which you have referred in your twelfth answer?

Ans. Yes, sir.

Int. 17. Is there anything by which you are enable' to state with certainty the time when said Swain first explained to you that water-wheel? Might it or not have been months before the year stated in your thirteenth answer?

Ans. It might have been before or after—months either way.

Int. 18. Please examine the letter now shown you (complainant's Exhibit J) and state whether you received it; and, if yea, in what way did you receive it, and state the time, as nearly as you can, when you received it, and how long you retained it in your possession?

Ans. I received it by mail. I can't state the time any further than it was in a reasonable time for a letter to arrive there. I retained it in my possession until about the year 1870.

Int. 19. You say you received it "in a reasonable time for a letter to arrive there"; a reasonable time from what date?

Ans. From the date of the letter.

Int. 20. Please refer to said letter, and read it carefully, and then state whether or not it describes or refers to such a water-wheel as you have in this deposition stated that said Swain explained to you.

Ans. It refers to said wheel, and describes it in part.

Int. 21. Please examine the letter now shown you (complainant's Exhibit K) and state when and how you received it, and about how long you retained it in your possession.

Ans. I received it by mail, not long after date of the letters, and retained it until about 1870.

Int. 22. Did you receive with it any drawings or sketches of a water wheel, or parts of a water wheel?

Ans. I did.

257 Int. 23. Please examine the sketches or tracings now shown you, marked Complainant's Exhibit L, and Complainant's Exhibit M, and state whether they are the ones referred to in your last answer. I, of course, do not include the cloth upon which they are now mounted for convenience, at request of defendant's counsel.

Ans. They are the drawings referred to.

Int. 24. Do these drawings and the last-named letter describe and represent such a wheel, or parts of such a wheel, as you have stated

in this deposition that said Swain explained to you before you went West?

Ans. To me, they do.

Int. 25. Did you part with these drawings at the same time that you did with the letters?

Ans. I did.

Int. 26. What did you do with said letters and drawings when they went out of your possession?

Ans. I gave them to Mr. A. M. Swain.

Int. 27. Please examine complainant's Exhibit E, including the wheel, case, and guides, and state, if you know, who made the same.

Ans. I made them in part—I made the patterns for them. I may have done some iron work, but can't be certain.

Int. 28. For whom, or at whose request?

Ans. At the request of Asa M. Swain.

Int. 29. How do these exhibits compare, as to character and construction, with the wheel described to you by said Swain before you moved West, and with the wheel illustrated and described in the drawings and letters just referred to?

Ans. They are the same substantially.

(No cross-examination.)

JOHN M. LOVETT.

Attest:

JOHN G. STETSON,
Examiner

Deposition of Joshua H. Sargent.

Direct examination by JOHN S. ABBOTT, Esq., of counsel for complainants.

BOSTON, *Dec.* 8, 1875.

Int. 1. Please state your name, age, residence, and occupation.

Ans. Joshua H. Sargent; thirty-eight; North Chelmsford, Mass.; machinist and millwright.

258 Int. 2. Where did you reside in the year 1857?

Ans. In the city of Lowell.

Int. 3. Where in 1858?

Ans. I resided a portion of the year in the State of New Hampshire, and the last part of the year in Lowell.

Int. 4. Were you, at that time, acquainted with Mr. Isaac Austin?

Ans. I was connected with his family by marriage.

Int. 5. Were you also then, and previously, acquainted with Asa M. Swain?

Ans. I was.

Int. 6. Did you know of a water wheel which was put in operation by said Swain for said Austin?

Ans. I did.

Int. 7. Were you present when it was set in the wheel-pit of said Austin's mill? If yea, state the time as accurately as you can.

Ans. I was. It was in the fall of 1858; December, I think.

Int. 8. Please examine the wheel Complainant's Exhibit R, and state whether it is the wheel referred to by you as set up in said Austin's wheel-pit.

Ans. I can't identify the wheel by any marks, but it is exactly similar to that wheel, except it is worn

Int. 9. From your examination of this wheel, and your recollection of the wheel that was set up in said Austin's wheel-pit, have you any doubt that this is the same wheel?

Ans. None whatever.

Int. 10. Where did you reside in the year 1855?

Ans. In the city of Lowell.

Int. 11. Were you at that time acquainted with said Swain and John M. Lovett?

Ans. I was.

Int. 12. During that year, did you and they attend a drawing school? If yea, state where, and, as nearly as you can, in what part of that year, and who kept the school.

Ans. We did; in the city of Lowell; in the fall of the year; our teacher's name was Robinson, known to us as Ben Robinson.

Int. 13. Are you well acquainted with the water wheel pat-
259 ented by said Swain? If yea, state as accurately as you can when you first knew it after the patent was obtained.

Ans. I am I knew it immediately after the patent was obtained.

Int. 14. Have you made or assisted in making or setting wheels made under that patent? If yea, state generally, according to your best recollection, when, where, and for whom.

Ans. I have; for Mr. Swain and the Swain Turbine Co. in 1864 to the present time—more or less of the time.

Int. 15. Were you in the employ of said Swain Turbine Co. at the time the Swain wheel was tested by Mr. Mills in 1869 and 1870?

Ans. I was.

Int. 16. Were you at that time acquainted with Waldo Whitney?

Ans. I was.

Int. 17. Was he present at any of the times when said Mills was testing the Swain wheel, as above referred to?

Ans. I cannot recall his presence there.

Int. 18. Did said Whitney have a wheel or wheels tested at the same flume about the same time?

Ans. He did, in a short time after.

Int. 19. Were you present at the time, and did you take any part in arranging the Whitney wheel for the testing; and was said Whitney also present?

Ans. I was, being employed by him for that purpose. He was present a portion of the time.

Int. 20. Prior to this testing of the Whitney wheel had you been acquainted with the wheel? If yea, state generally in what way and to what extent you had known it.

Ans. I had. I had seen it at the manufactory in process of construction—various sizes. I had seen it at the mills and occasionally on the cars.

Int. 21. For about how long a time prior to this testing had you been acquainted with the Whitney wheel?

Ans. Several years. I can't tell exactly.

Int. 22. To what manufactory do you refer in your twentieth answer; and where was it situated?

260 Ans. I refer to the manufactory of Mr. Whitney, for manufacturing his water wheels, in Leominster, Mass.

Int. 23. Prior to the said testing of the Whitney wheel did said Whitney employ you, or attempt to employ you, to work for him on water wheels?

Ans. He did.

Int. 24. Have you been in said Whitney's shop, where he makes his wheels, several times?

Ans. I have.

Int. 25. Please state whether, when you were in said shop at the times referred to, there was more than one kind of wheel being made in that shop, as to its mechanical construction.

Ans. I never saw but one kind there.

Int. 26. And while you were there, did you have such opportunities of observation that you would have seen and known if more than one kind of water wheel was being constructed there?

Ans. I did.

Int. 27. Please examine the water wheel marked Complainant's Exhibit T, and state whether there is any substantial difference, in mechanical construction, between this wheel, Exhibit T, and the various Whitney wheels to which you have referred in this deposition.

Ans. There is no substantial difference, either in mechanical construction or principle.

Int. 28. Did you ever work or commence working for said Whitney? And, if yea, state when, as accurately as you can, and where.

Ans. I did; in Lowell in the fall of 1870, and at Leominster in the same fall.

Int. 29. For what purpose or object were you employed, and what did you do?

Ans. At Lowell I was employed to set a water wheel in a testing flume in one instance; and at Leominster I was employed to work up a wheel for Mr. Whitney; at commencing I made a drawing, or rather a sketch—that was about all.

Int. 30. What was done with the drawing or sketch referred to in your last answer?

261 Ans. I have no knowledge.

Int. 31. What did you do with it, and where did you leave it?

Ans. I left it pinned on the drawing board at the office of Mr. Whitney, at his shop in Leominster.

Int. 32. Are you now in the employ of the complainants in this case? If not, how long since you last worked for them?

Ans. I am not; four years since I last worked for them.

Int. 33. Can you make such drawing or sketch as referred to in your twenty-ninth answer? If yea, please do so.

Ans. I can make a similar one—possibly not exactly the same in details.

(Sketch made and produced, and marked Complainant's Exhibit C, J. G. S., Examiner.)

Int. 34. Was the above sketch made here when and while you were being examined?

Ans. It was.

Int. 35. Is it of the same size and style of finish as the sketch before spoken of, which you made for Whitney?

Ans. It is not. The sketch spoken of was drawn to a scale of full size, and was a working sketch; and this was hurriedly made, without proper paper or instruments, and was simply intended to represent the principle.

Int. 36. And does it also represent the form, proportionally and substantially, so far as you remember?

Ans. It does, as near as I could approximate to it, under the circumstances.

BOSTON, *Dec.* 11, 1875.

Cross-examination by C. E. MITCHELL, esq., of counsel for defendants.

Cross-int. 37. When did you commence to work for Mr. Whitney, and when did you cease?

Ans. I commenced in the fall of 1871, and ceased in the same fall.

Cross-int. 38. I am not certain whether the brass model Exhibit No. 14 was used by Whitney as a model for his wheel during the
262 time you so worked for him; will you please give me any knowledge you can about it?

(Objected to as inadmissible, and the admissibility of the model objected to.)

Ans. I never saw this model, as I know of before the present hearing.

Cross-int. 39. Did any of the Whitney wheels that you saw have a disc connecting the lower edges of the crown to the hub, so that the water could not flow between the hub and crown, as in the "spoke construction"?

Ans. They did.

Cross-int. 40. And did the discharge lines of the floats in the construction which I will call the "disc construction" extend from the lower edge of the disc downward and outward to the lower edge of the band?

Ans. They extended outward, but to best of my recollection, but little, if any, downward.

Cross-int. 41. The question asks between what two points the discharge line of the floats extended; that is to say, whether they did not extend from the lower edge of the disc to the lower edge of the band?

Ans. They extended from the hub of the wheel to the lower band.

Cross-int. 42. Well, do you mean to swear that they did not extend from the level of the disc to the band?

Ans. I am not certain at what point the hub and disc were connected.

Cross-int. 43. Then I understand you to say that you do not swear that the discharge lines did not extend from the discs down?

Ans. Yes, sir.

J. H. SARGENT.

Attest:

JOHN G. STETSON, *Examiner.*

263 *Deposition of William E. Clarke.*

Direct examination by J. S. ABBOTT, esq., of counsel for complainants.

BOSTON, *Dec.* 8, 1875.

Int. 1. Please state your name, age, residence, and occupation.

Ans. William E. Clarke; sixty-seven; Newton Upper Falls, Mass.; machinist.

Int. 2. Where did you reside, and in what were you engaged, in the year 1858?

Ans. I resided in Lowell, and was engaged in building cotton machinery and tools.

Int. 3. In what machine shop?

Ans. In the Lowell Machine Shop.

Int. 4. Did you do any other work that year in that shop, excepting what you have stated in your second answer?

Ans. I did do the iron work for a water-wheel which Mr. Swain had projected.

Int. 5. For whose use was that water-wheel made?

Ans. For a Mr. Austin, who was a file maker, I think, at that time, in a place called Belvidere—a part of Lowell.

Int. 6. Please state, if you remember, in what part of the year 1858 that wheel was made or completed.

Ans. In November, or in the fore part of December; I am not certain which.

Int. 7. Please examine the wheel marked Complainant's Exhibit R, and state whether or not it is the wheel to which you refer in your fourth answer.

Ans. I have no doubt this is the wheel.

Int. 8. In your fourth answer you speak of a "Mr. Swain"; do you mean Asa M. Swain, now present, the patentee of the Swain water-wheel?

Ans. I do.

Int. 9. Did you know of said Swain making experiments with water-wheels in that machine shop before the making of the said Austin wheel?

264 Ans. I did know of his making experiments, but did not witness them, in the yard of that shop.

Int. 10. Please refer to the drawing or plan now shown you, marked Exhibit N, and state as accurately as you can when you first saw it.

Ans. I think I saw this drawing before the building of the Austin wheel, in August or September, 1858—this one or one similar to it; or, I might say, precisely like it.

Int. 11. Please state whether or not, when the said Austin wheel was made, there was a continuous series of guides surrounding the wheel for directing the water upon the buckets of the wheel, and a gate to regulate the supply of water.

Ans. There was a series of guides around the wheel, and a gate to regulate the supply.

Int. 12. Is there a shop or factory at Newton Upper Falls, in which you are interested, or engaged as a machinist?

Ans. There is a shop there in which I am engaged as superintendent—a machine shop.

Int. 13. Do you use in that shop water or steam power?

Ans. Both; it is on a small stream. We use both steam and water.

Int. 14. What kind of water-wheel do you use there?

Ans. We use a Swain wheel.

Int. 15. How long has that wheel been used there, and has it given good satisfaction?

Ans. I have forgotten exactly when it was put in, but I think certainly eight years—it may have been ten—it has given good satisfaction. I am positive it has been eight years, and it may have been ten, that it has been used there.

Int. 16. How does that wheel, as to its mechanical construction and mode of operation, compare with the Austin wheel, referred to and described in this deposition?

Ans. It is very similar—in fact the construction is the same of the wheel and its surroundings—only the putting into a different situation—so far as I remember.

(No cross-examination.)

WM. E. CLARKE.

Attest:

JOHN G. STETSON, *Examiner.*

265 *Deposition of Jotham Hartshorn.*

Direct examination by J. S. ABBOTT, Esq., of counsel for complainants.

BOSTON, *Dec.* 10, 1875.

Int. 1. Please state your name, age, residence, and occupation?

Ans. Jotham Hartshorn; seventy-two last March; Amherst, N. H.; farmer, and in the lumbering business.

Int. 2. Are you acquainted with Waldo Whitney? If yea, about how long have you been acquainted with him?

Ans. I have known him some eighteen or nineteen years.

Int. 3. Did you ever purchase or procure from said Whitney a twenty-four inch water wheel? If yea, state the time when, as accurately as you can, and what use you made of it, and where?

Ans. I did. I contracted for it in the fall of 1856. He brought it to me in May, 1857. It was used mostly for sawing shingles the first two years; since that time we have used it for running a planing machine, principally, in Amherst, N. H.

Int. 4. Is that wheel still in your possession? If not, when did you part with it, and to whom?

Ans. It is not. I let Mr. Swain have it the last of last October.

Int. 5. Did you ever procure or receive from said Whitney any other twenty-four inch water-wheel?

Ans. No, sir; no other of that size.

Int. 6. Please examine the water-wheel marked Complainant's Exhibit T, and state whether it is the wheel which said Whitney sold you, and to which you have referred in this deposition?

Ans. I should think that is the wheel.

Int. 7. Have you any doubt that is the wheel?

Ans. I have not.

Int. 8. Was the building a saw-mill in which this wheel was used?

Ans. Yes, sir; we had a saw-mill in one end of the building.

Int. 9. Are you acquainted with Mr. James E. Ladd, the defendant in this case?

266 Ans. I am not acquainted with him; don't know that I have seen him but once; shouldn't know him again.

Int. 10. Were said Ladd and said Whitney at your saw-mill examining or inquiring about this wheel? If yes, state the time when.

Ans. There was a man came there with Mr. Whitney, and he was introduced to me as being Mr. Ladd. I think it was in March last.

Cross-examination by C. E. MITCHELL, Esq., of counsel for defendants.

Cross-int. 11. Mr. Hartshorn, how long did you use the wheel you bought of Mr. Whitney?

Ans. We used it from 1857, till Mr. Swain took it in October last.

Cross-int. 12. Was it in good working condition when Mr. Swain took it in October last?

Ans. For aught I know.

Cross-int. 13. What kind of a wheel was it for power and efficiency?

Ans. It answered our purpose very well.

Cross-int. 14. Was there any portion of the wheel from one side to the other on a level with the lower edge of the band from which the water did not discharge when the wheel was in use?

(Objected to as improper in cross-examination.)

Ans. I couldn't tell.

Cross-int. 15. Was the wheel so situated that you couldn't see?
Ans. It was.

JOTHAM HARTSHORN.

Attest:

JOHN G. STETSON, *Examiner.*

Deposition of William C. Hibbard.

Direct examination by counsel for complainant:

BOSTON, *Dec.* 2, 1875.

Int. 1. What is your name, age, residence, and occupation?
Ans. William C. Hibbard; sixty-one; Boston, Mass.; mechanical engineer and expert in patent causes.

267 Int. 2. Have you had any experience in the science of hydraulics? If yea, state what experience.

Ans. I have; considerable. In the early part of my life I had occasion to make several water-wheels, and to work in making them under the direction of others, and during the course of my business life I have given attention to hydraulics to a considerable extent, as a part of my business education as a mechanical engineer, and a few years since I had occasion to construct some large centrifugal pumps from designs of my own, which, in construction and operation, are somewhat similar to the action of a turbine water-wheel reversed; and in constructing them I had occasion to investigate the operation of the water in them, and to calculate the form and dimensions of the various parts of the machine to adapt it to its work, the size and proportion of which were carefully estimated for all parts of it. I have also had occasion to investigate this subject of turbines, and also the state of the art as exhibited in the matters produced in evidence, in a case wherein I was an expert. These, in connection with such matters as appear from time to time in my current mechanical reading, constitute substantially my means of knowledge in relation to this subject.

Adjourned.

BOSTON, *Dec.* 3, 1875.

Int. 3. Have you examined complainant's exhibits in this case, marked from A to Z inclusive (excepting Exhibits C, J and K), and also the defendant's exhibits in this case, marked 1 to 7 and 10 to 13 inclusive, and the two sketches on paper marked Exhibit Sketch of 1837 Wheel, and Exhibit Sketch of 1841 Wheel, also the testimony of defendant's witnesses, Stowe and Renwick? If yea, do you understand all these various exhibits, and the testimony referred to, as to their several statements and descriptions, together with the principle, construction, operation and effect of the various wheels referred to?

Ans. I have examined the several exhibits mentioned and the several pieces of testimony, by reading them through carefully, and retain a general recollection of the matters contained in them; and I also

268 understand the construction and operation, I think, of the several wheels represented by those exhibits, so far as they represent water-wheels, and believe that I fully understand the construction and mode of operation intended to be represented by those exhibits.

Int. 4. Referring to the reissued letters patent No. 5,154 (Complainant's Exhibit B), and the description and drawings thereof, please state whether they are full and complete enough to enable a person skilled in hydraulics, pertaining to motors, to make a turbine therefrom, such as

is shown, described and claimed, without the necessity of invention or experiment on the part of such skilled person?

Ans. They are.

Int. 5. State whether or not said reissued letters patent contain a description of the mode of constructing a bucket so as to produce a wheel "having an effective inward flow and discharge of part of the water and an effective downward flow and discharge of part of the water simultaneously in one wheel, whereby the effective area of discharge is increased without increasing the diameter of the wheel"?

Ans. They do.

Int. 6. State whether or not the buckets described and shown in said reissued letters patent are substantially the same as those shown in certified copies of the drawings, and the duplicate of the model filed with said original patent, being complainant's Exhibits W and E.?

Ans. They appear to be substantially the same in each.

Int. 7. The fifth claim of complainant's reissue is in these words: "A water-wheel having an effective inward flow and discharge of *of* part of the water, and an effective downward flow and discharge of part of the water, simultaneously in one wheel, whereby the effective area of discharge is increased without increasing the diameter of the wheel." Will you state what is the mechanical construction described in the preceding parts of the specification, which is necessary to the performance of the function referred to?

Ans. The details of the construction of the wheel would require me to repeat the description throughout, so far as regards those parts which determine the flow of the water through the wheel in all parts; but it may be stated briefly in a general way, thus: that there is a crown
269 to the wheel which forms the upper surface of the passage through which the water passes in passing through the wheel into the interior of it, and to which the top ends of the buckets are secured on which the water acts in its passage through the wheel; and also serves to connect the operative part of the wheel to its shaft. The series of buckets extend to the bottom of the wheel and are open on their inner and lower edges, so that the water leaves them in a direction at their upper part towards the centre of the wheel, and varying in all directions from that towards the lower edge of the buckets at the outside of the wheel, at which point the direction of discharge is downward substantially, as regards the axis of the wheel. In the wheel represented, there is also a band represented around the bottom of the wheel, which connects all the floats together and is useful to give the wheel by practical means the necessary strength, but is not necessary, in my judgment, to produce a downward and inward flow and discharge of the water. This general property of construction recited in the claim is produced by making the discharge line of the bucket to extend all the way from the crown of the wheel or top edge of the bucket around to the lower edge of the bucket at the outside of the wheel; by this means the area of discharge can be made the largest practicable which can be produced in a wheel of a given diameter, because it enables the volume of water which can flow through the wheel to be as great as can be discharged through a circle of as great area as the outside diameter of the wheel, less the space occupied by the parts of the wheel itself, made of as small dimensions as are suitable to sustain the strains which are imparted to the wheel by the water, and to transmit the same to the shaft properly. The buckets are to be of such form at the upper part as to meet the conditions of a centre-vent wheel, and at the lower part of such form as to meet the conditions of a Jonval wheel substan-

tially, and the water is supplied to the floats of the wheel in the form of a vortex, to conduct the water properly to the floats, and which, in this wheel, is done by tangential guides arranged around the circumference.

Int. 8. What do you understand to be the meaning of the following extract from the reissued letters patent: "The upper horizontal edge of the floats is attached to the crown of the wheel, and the outer lower edge may be attached to a band"?

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Ans. I understand from this that the float is a curved plate, the top edge of which is attached to the crown of the wheel; and that each float at the bottom is attached to a band surrounding the wheel, to keep the floats in proper relation to each other; and that all the space between the two parts named, i. e. the crown and the band, is left open for a passage for the water, and that the floats are unsupported in any way, except by these two parts of the wheel, i. e. the crown and the band.

Int. 9. Please state whether the phrase "The upper horizontal edge of the floats' in the above extract, taken in connection with what precedes that extract in the reissued letters patent, and the specification of the same, implies, or necessarily implies, that the upper edge of the floats is exactly or strictly horizontal, and please give your reasons for the answer.

Ans. It certainly does not imply that because the drawings to which the description refers show that the "Upper horizontal edge of the floats" at which the float is attached to the crown is shown to be a curve, the extreme outer part being horizontal and gradually curving downward towards the inner edge; and the description in the patent, I understand, is to be construed as being in accordance with the representation of the thing it is describing, and as a matter of fact, in my opinion, the mode of operation of the wheel would be the same substantially, whether the upper edge of the float was exactly straight horizontally, or curved downward, as shown. The downward curvature at the inner edge of the float having only the purpose of giving a form to the walls of passage in the wheel which will offer the least resistance to the water flowing through it, and at the same time afford a proper area in cross section to such passage, it is, at best, a mere matter of form, which is not essential to the principles of construction which is embodied in that wheel.

Int. 10. Are the drawings of the reissued letters patent, Complainant's Exhibit B, substantially like the drawings of the original letters patent, Complainant's Exhibit W?

Ans. They appear to me to be substantially the same, except the drawing W appears to be the more nicely executed of the two.

Int. 11. Please refer to that part of said original letters patent which is in the following language: "When J is lowered, the water strikes the floats with all the force and velocity due to its head directly under the rim of the wheel, which is so curved as to force the water down rapidly on the lower curved parts or bottoms of the floats." Does this language correctly express the action or operation of the water in a wheel when doing its proper work, made substantially as shown in the certified copy of the drawings of the original letters patent, Complainant's Exhibit W, or like the duplicate of the original Patent Office model, Complainant's Exhibit E?

271

Ans. In my opinion it does not, although it is not entirely incorrect; the language seems to imply that the water is admitted only at the upper part of the float, which is not correct; and it also appears to imply that there would be no useful downward action of the water upon

the floats in the lower part of the wheel if it were not for the curvature of the upper part of the crown plates, which is, in my judgment, erroneous, as the water would be as efficient substantially upon the lower part of the floats if the under side of the crown was a plain horizontal surface. The only use of the curvature, in my opinion, is, that it gives to the walls of the space through which the water flows a form which offers the least resistance to the water in flowing through it. It is to be noticed in this connection that all the water is received horizontally to all parts of the wheel, and before it passes out of the wheel its direction of motion is changed to a vertical one, moving downward, and this change in direction of the motion of the water has to be all effected within the wheel, or before it reaches the lower edge of the wheel; and that is accomplished with least resistance when the form of the passage is such as to give a curved direction to the water from the horizontal to the vertical, such as is shown in the drawings of the Swain wheel. In my judgment, the wheel as a whole shows substantially the best form of the parts to accomplish that especial object, that is, to give a form of passage through the wheel of least resistance to the water; and the language quoted also implies an action of the water which is inconsistent with the action of the water in a centre-
vent wheel, which is the action of the upper part of this wheel;
272 because the action of the water in the upper part of the wheel
which escapes inward would intercept any immediate action or relation between the form of the crown above the central discharge and the lower part of the wheel where the discharge is downward, for obvious reasons.

Int. 12. State what substantial or material difference would exist, if any, in principle, character, or operation of wheels made in strict conformity with Complainant's Exhibits B, E, F, I, N, P, Q, R, S, U', W, and X.

Ans. There is no material difference between them; they are all, in my judgment, substantially the same thing, with slight and immaterial variation in form of the different parts.

Int. 13. Supposing four wheels were made substantially as shown in the certified copy marked Complainant's Exhibit W, and the duplicate Patent Office model filed with said original Swain patent, marked Complainant's Exhibit E, varying only in their respective crowns as follows, to wit: One having its crown curved exactly as shown in Complainant's Exhibits W and E; another having its crown perfectly horizontal; another having a straight under surface to the crown, with the inner edge dropped as much below the outer edge as the inner edge of the crowns shown in Complainant's Exhibits W and E is below the outer edge; the fourth with the crown having its under surface in a radial vertical plane, convex, with its inner and outer edges in the same horizontal plane—what difference would be found, if any, in their principle, operation, character, and effect in consequence of the difference in their crowns?

Ans. There would be no substantial difference, in my opinion, in any of the wheels supposed; the principle, mode of operation, and result in each case would be the same. The modifications or forms supposed as to the form of that part of the wheel would neither introduce any modification in the mode of operation, nor deprive it of any of its characteristics which distinguish that wheel from others.

Int. 14. What is the object or office of the upper crown of a centre-vent turbine?

Ans. Its object is to form a support for the buckets or floats, to form

the upper side of the passage through which the water flows, and to connect the wheel with the shaft that supports it in position by any suitable connecting part.

273 Int. 15. When said patented Swain wheel is doing its best work, how, in what direction or directions, does the water enter the buckets, and how is it discharged from them?

Ans. It enters the wheel horizontally, in a direction tangential to the wheel, and after passing around the wheel in a helical and spiral direction is discharged in the direction which is in a plane passing through the axis of the wheel; that is, to leave the wheel without rotation; and also at the upper part of the wheel, in a direction nearly radial and horizontal, and varying from that direction to vertically downward at the lower and outer extremity of the float.

Int. 16. What is the cause of the course of the water being changed after it enters the buckets of the wheel, as you have stated?

Ans. It is owing to the action of the water flowing into the wheel in a tangential direction, as before stated; to the form of the passage through the wheel; and to the rotative motion of the wheel itself; and to the form of the buckets acting jointly and simultaneously.

Int. 17. Suppose the water at the points of its entry into the floats of the patented Swain turbine was divided into ten equal, horizontal sections, or regarded as composed of ten equal horizontal portions, would such sections or horizontal portions maintain the same proportions and directions on reaching the discharge edges of the buckets? And would the same proportions and directions exist on a horizontal plane even with the lower outer edge of the buckets? If not, how would they differ? State fully.

Ans. They would not. They commence to change from the instant of entering the wheel and continue to change until they leave it, from several causes. Take, for instance, the upper stratum of water, as stated in the question, it commences to occupy a greater space vertically in a radial direction by the constantly diminishing circumference of the path in which it moves; it also changes from the constantly retarded motion of the water in the direction of the circumference, which it has to do in order to give out its work to the wheel. It is also constantly changing by reason of the form of the buckets and their relation to the motion

274 of the wheel; it is also constantly changing by reason of the constantly varying cross sections of the passage for the water through the wheel; and also by reason of the difference of the lengths of the paths through the wheel in which the different portions of the water move, from the point of entrance to the point of discharge. All these are acting simultaneously and consequently render any definite speculation as to the ultimate form of such portions of water at the instant of discharge practically impossible. Stated in a general way the part of the water which enters at the top would be likely to find its discharge from the float towards the top in a substantially horizontal direction or towards the axis of the wheel; and the part which enters at the bottom would find its discharge at the outside of the wheel downward; and the portion which enters at the top would occupy a greater space in a radial direction when it passes out at the bottom of the wheel than the part which enters at the bottom of the wheel and passes out at the bottom, for the reason that on the supposition of the question the quantity of water which passes out at the bottom and near the circumference is supposed to be substantially the same and to require equal areas of discharge at the bottom of the wheel, which would of course occupy a

greater space in a radial direction nearer the centre than towards the circumference.

Int. 18. Would the course of the water entering the bucket just below the crown until it leaves the bucket correspond with the curvature of the crown in a radical direction?

Ans. It would not. The path which a particle of water under the conditions of the question would describe in passing through the wheel would be the resultant of the curvature of the crown, the circumferential motion of the wheel during the time the water was within the buckets, and the centripetal motion of the water in passing through the bucket. Such a curve or path developed upon a plain surface would be very different from that represented in the drawings of the reissued patent or Exhibit W, in which the curvature represented is that of the crown of the wheel only in a radical direction. It would be a curve of a much less degree of curvature than that shown in the patent, and the path as long as from a quarter to a half of the circumference of the wheel.

275 Int. 19. What difference, if any, do you find in principle, construction, operation and effect between the Haseltine wheel, so called (complainant's Exhibit Y), and the Whitney wheel (complainant's Exhibit T)?

Ans. The general principle and mode of operation of the two wheels I regard as being substantially the same. Exhibit T has a crown which is attached to and covers the upper ends of the floats, which Exhibit Y does not have, but they are both substantially, as to their discharge, wheels of the Jonval type, with what I regard as very defective proportions.

Int. 20. State whether or not the illustration of the wheel, Fig. No. 1, on the Whitney circular (complainant's Exhibit X), is substantially that of a wheel made in conformity with the reissued Letters Patent No. 5154 (complainant's Exhibit B), as far as the parts of the wheel in Fig. No. 1 are shown?

Ans. In my opinion the wheel shown in Exhibit X, No. 1, is substantially the same as that shown in the Swain reissue Exhibit B, and a pretty close imitation of it.

Adjourned.

BOSTON, *Dec.* 4, 1875.

Int. 21. State whether or not the certified copy from the Patent Office of the drawings of the Leffel turbine, complainant's Exhibit V, illustrate a turbine substantially like said patented Swain turbine in character, principle, operation and effect.

Ans. It does so far as regards the general character of the wheel in having a part of the water which passes though it act in the manner of a centre-vent wheel, discharging inwardly, and the other part of the water discharge downwardly in the manner of the Jonval wheel, and that they are both united in the same wheel, and give the increased capacity to the wheel which is due to that united action. The wheel is also used in a case which surrounds the same, to produce a vortex in the water which enters upon the wheel in a substantially tangential direction entirely aronnd the wheel, by means of suitable guides to give direction to the water. The details of the construction are somewhat different from those in the Swain wheel, but these differences do not in any degree divest the Leffel wheel of those characteristics of its

276 construction and operation which are before referred to, but on the contrary they are all constructed with strict reference to that

general mode of constructing the wheel and its casing, and that mode of receiving and discharging the water which I mentioned; and this Leffel wheel also embodies substantially the advantages in construction which are set forth in Swain's reissue, which are due to the combination in one wheel of the inward flow of part of the water and the downward flow of part of the water, both acting simultaneously.

Int. 22. I now request your attention to the testimony of John L. Stowe in this case, so far as it is descriptive of the wheels claimed to have been made by him in 1837, 1841 and 1850, and the exhibits referred to by him relating to said wheels, which in your third answer you say you have carefully examined and understand. Please state wherein the said wheels, which he states were made by him in 1837, 1841 and 1850, as shown and illustrated by said exhibits and as described by him, differ from the complainant's said patented turbine; and if differences exist, state whether they are substantial and material. The exhibits referred to in this question are defendant's Exhibits 2, 3, and 7, and Exhibit Sketch of 1837 Wheel.

Ans. The wheels built by Stowe, as I understand his description, were of a substantially different kind as compared with the Swain turbine described in the reissue, and are in no sense turbines at all, as the word is used in mill work. They were simply common impulse wheels, which receive their power from a stream of water acting upon one side only, the rest of the wheel being entirely idle; that is, that all the circumference of the wheel, excepting the small portion contiguous to the spout, not being acted upon by the water, such wheels have no casing or guides other than the spout, but work in the open air, and do not in any degree have a vortex of water formed, in the centre of which the wheel works, as is the case in the turbine. In a turbine, also, the water which acts upon the wheel flows through it and between the floats in an unbroken current, and the wheel in all parts works in a solid, unbroken mass of water, and its power is derived from the water by the pressure of the water upon the surface of the floats in all parts around the wheel. These characteristics, which I have
277 named as pertaining to water wheels, are always found, I believe, in some form in any water wheel which can be appropriately called a turbine, and not one of these properties, as I recollect, is found in the wheel described by Stowe, as I understand it, and therefore can hardly furnish grounds of legitimate comparison between such wheels and turbines; and the mode of construction described by Stowe is not such as could be used in a turbine, practically, for this reason: As I before stated, the water which actuates the turbine flows through it, entering the buckets at one side, and discharged therefrom from the opposite side. This is true of all turbines, whether the water flows inwardly, outwardly, or parallel to the axis, or in any intermediate direction, and therefore it is necessary that the blades or floats should be made of metal, and thin, and no form of the construction of the floats, if made of wood, and thick, and as clumsily as a wooden wheel must be made, could practically answer the purpose for a turbine. These wheels of Stowe's I do not understand to have had any casing at all, or anything to answer the purpose of a casing, and that of itself would be enough to make it a substantially different kind of a wheel from that shown in Swain's reissue; and this difference is not only substantial, but is, in my judgment, vital, in the construction of a turbine in any form. I omitted to state, in its proper connection, that wheels of the kind made by Stowe have no inward or downward discharge of the water such as is so called in the Swain reissue, because the water escapes from such

wheels substantially in a tangential direction outside of the wheel, and only the scattering water passes inward or downward, such as is thrown laterally by the resistance of the face of the floats to the water as it strikes them. For these reasons, in my opinion, the wheels made by Stowe cannot be regarded as substantially the same as the wheel described in Swain's reissue now in question, either as a whole, or as to the material parts.

Int. 23. What amount of power is required to run back a saw-mill carriage?

Ans. That depends on the weight of the log, say from half a horse-power to two horse-power, occupying the time of from a few seconds to, say, a minute, and used after each cut of the saw through the log is completed.

278 Int. 24. I now request your attention to the Greenleaf patent, defendant's Exhibit No. 10, and the four certified models, complainant's Exhibit Z, also referred to in your third answer. Please compare the same with the complainant's said patented turbine, and state fully what differences, if any, you find, and whether such differences are substantial and material.

Ans. This Greenleaf wheel in any of the forms represented by the four models is not like the Swain wheel shown and described in the reissue, either as a whole or as to its several essential parts. It might be properly described as having a scroll case, with no guides to direct the water into the wheel other than is given to the interior form of the case generally. It has no floats having such character as befits the operation of either a centre-vent wheel or a Jonval wheel, but the passages for the water are so formed as to operate like what is called a reaction wheel; and it may be said, in a general way, of them, in any of the forms represented, that the peculiar properties of the centre-vent and Jonval wheels united in one wheel are not to be found in this, and it cannot well possess such properties, because, as I understand the drawings and models, the wheels are intended to work on a horizontal axis, and therefore the details of the several parts are not such as are required to permit the union of those properties in the way they are united in both the complainant's and respondent's wheels; that is to say, that there is no part of the wheel which can properly be said to act as a centre-vent wheel, and no part of it as a Jonval wheel, and exhibits in no part the peculiar principles of construction by which they are united and co-operate as in the complainant's and respondent's wheels. The Greenleaf wheels in either of the forms appear to me to be substantially different from the complainant's wheel in every material part; that is, in the case, in the means for guiding the water on to the wheel, and in the floats and modes of attachment of them to the other parts of the wheel, and in the character of discharge of the water from the floats; and I also can see no properties in the Greenleaf wheel which appear to have any reference to the construction of a wheel that will have a maximum capacity of useful effect within a given diameter of wheel. I there-

279 fore regard them as being substantially and radically different in form and combination of parts, mode of operation, and result.

Int. 25. I now request your attention to the description in the Whitney patent (defendant's Exhibit No. 11) and the Hartshorn wheel, so called (complainant's Exhibit T), being the wheel referred to in the "agreement" in this case, both of which are also referred to in your third answer. Please compare the same with complainant's said patented turbine, and state fully what differences, if any, you find, and whether such differences are substantial and material.

Ans. This Hartshorn wheel, which is now present, is simply a modification of the Jonval wheel, and has all the limitations of capacity that the Jonval wheel has, and none of the properties which enables a part of the water to be discharged in the way that it is discharged in the centre-vent wheel, so called. It has, as a device peculiar to this wheel, as described in this patent, what is called an inverted cone, by which the water, which is all received horizontally, is deflected and turned downward in the buckets, and before it is discharged, so that it is all discharged downward, substantially the same as in the Jonval wheel; therefore it has no central discharge, nor any space in the wheel to receive it, and the capacity of the wheel is entirely limited by its construction to what can be discharged downward, and outside of the solid central part of the wheel. Now this might approximate the area which is permitted in the complainant's wheel by its construction, but in practice I consider that the breadth of bucket in the Jonval wheel is limited to a narrow annular space around the circumference, because the difference in the velocity of the edge of the buckets at different distances from the centre of the wheel varies in proportion to such distances, while the velocity of the water at the discharge is nearly the same, or, in other words, the discharge edge of the buckets, to get the best effect, is to be kept at a considerable distance from the centre, leaving the central space to serve merely as passage for the water after it has left the buckets, instead of having that space occupied by the water which flows into the buckets, and occupies that space before it is discharged from them. From this difference in the construction of the wheel it follows
280 that in the complainant's wheel this central space can receive a central discharge from the buckets in addition to the downward discharge from the buckets at the circumference, and in intermediate direction between the two, which is a condition of things that is not possible in the Hartshorn wheel, and which, as I understand it, is the property now immediately in question.

Int. 26. Please examine complainant's exhibits marked L, M, N, W, and U[1], and Pl. I in exhibit marked P, and the Pl. I and Pl. II and Pl. III in exhibit marked Q, and state whether they all severally show wheels having substantially the same construction and operation as shown and described in the said reissued patent No. 5154.

Ans. They do.

Int. 27. Please examine defendant's Exhibit 1, and state whether or not it embodies the properties claimed in the said reissued patent No. 5154.

Ans. It does, some of them, and especially as regards the method of receiving and discharging the water from the wheel, and the use of the case in connection with the wheel, but it differs from the complainant's wheel in the detail of the construction of the gates and chutes, and in the proportions of the parts.

Int. 28. What are the requisites of a turbine as to the application of the water to it and its action upon it?

Ans. Stated generally, the water must be made to form a vortex around the wheel before it enters the wheel, which is generally accomplished by surrounding the wheel with a series of inclined guides which direct the water tangentially to the wheel; a gate of some kind to determine the volume of water that shall flow upon the wheel at any given time; a case which, in connection with the wheel, determines the course in which the water shall flow through the wheel; a series of buckets of appropriate shape attached to the wheel, between which the water flows, and upon which the water presses to impart motion to the wheel; means

or space for permitting the water to escape from the buckets after it has done its work upon them; and the conditions under which the parts work are, that the wheel and casing, so far as concerns the operation of the wheel, are to be entirely filled with water, so that the form of the case and wheel taken together substantially determine the direc-
281 tion through which the water shall flow in passing through the machine. These different conditions are modified as to form and adapted more or less harmoniously to each other, according to the opinion of the constructor as to what will best accomplish the result, which may be stated in a general way to be to receive the water at the highest velocity without a shock, and to discharge it after it has done its work with the least velocity practicable.

Int. 29. Would the crown of said patented Swain wheel, if made substantially as shown in the certified copy of the drawings of the original patent (complainant's Exhibit W), or like complainant's Exhibit E, or as shown and described in the said reissued patent No. 5,154, as to its curvature, in any way or degree retard the operation of the water passing through or over the buckets of the wheel?

Ans. It would not. It is obviously intended to facilitate the passage of the water through the wheel by that construction, and I have no doubt it does it.

Int. 30. State what you understand to be the points of substantial similarity in the wheels referred to in the stipulation on page 13 of the printed record in this case, and complainant's patented Swain wheel, as shown and described in the reissue No. 5,154 (complainant's Exhibit B.)

Ans. I understand the wheels that are described in the stipulation have their wheel parts made substantially like Exhibit D, which is produced, and that they were made to work in casings which surround the said wheels and receive the water upon the wheels around the circumference in a tangential direction, by means of guides, being substantially such as are represented in the pamphlet, complainant's Exhibit O, on page 4; and the points of similarity between them and the complainant's reissued patent are such as are set forth in the first, second, third, and fifth claims of the said reissued patent, the principles of which claims are, in my judgment, as fully embodied in said exhibits stipulated as in the wheel especially described in said reissue.

Int. 31. Suppose the crown of the wheel referred to in the stipulation on page 13 was horizontal, or nearly so, from the outer to the inner
282 edges of the buckets, and the crown of complainant's wheel was made with its under surface curved, as shown in the certified copy of the drawings of the orignal Swain patent, Complainant's Exhibit W; what difference would be found, if any, when said wheels were in operation, doing their best work, in their principle, character, operation, or practical effect?

Ans. No substantial difference whatever, in my opinion.

Int. 32. Is said Swain patented turbine a new type of wheel, or simply a combination of different parts of old wheels?

Ans. I regard it as a new type of wheel, in which the wheel while embracing the properties of old wheels dispenses with some of the parts which were necessary to such old wheels, thus giving it, as it were, a compound character in a single wheel.

Int. 33. Is there in complainant's Exhibit E sufficient space or area under the coupling of the wheel inside of the inner edges of the buckets for the water discharged by the upper or centre-vent part of the wheel to pass into and off without occupying any of the space due to the

water discharged from the lower or Jonval part of the buckets of said wheel?

Ans. In my judgment, there is.

Int. 34. Is the capacity of a wheel like Complainant's Exhibit E greater than either a properly constructed centre-vent turbine or a properly constructed Jonval turbine of the same diameter?

Ans. It is, considerably.

Int. 35. How do such wheels as said Stowe claims to have made in 1837, 1841, and 1850, and also the said Greenleaf wheel, compare with the said patented Swain turbine, in capacity and efficiency?

Ans. They are, in my judgment, very much inferior. I have no doubt of it, although I have never tested either of them.

Adjourned.

BOSTON, *Dec.* 22, 1875.

Cross-examination by C. E. MITCHELL, esq., of counsel for defendant:

Cross-int. 36. In reply to question 11 you state that "the only use of the curvature" (referring to the curvature of the crown), "in my opinion, is that it gives to the walls of the space through which the water flows a form which offers the least resistance to the water
283 flowing through it"; do you know why the Swain wheel shown on Plate II of Exhibit P, and the wheel shown in Complainant's Exhibit Q, which wheels are said to have been tested with first-class results, and which are said to represent the Swain wheel as now made, have crowns which are substantially horizontal within the limits of the floats?

Ans. I do not, except so far as I am able to judge from the construction of the wheel itself, which I suppose to be this, that by this difference of form, as compared with the form shown in the patent, the inner edge of the float as thereby made longer, and thereby a greater length of discharge space is permitted, and thereby also a less angle of inclination is given to the floats, as compared with the direction of the motion of the floats, and consequently less velocity of the water escaping from the floats, and less space between the floats to give the same aggregate discharge space; while the space within the inner edges of the floats still presents the same curvature in kind, although of a little less radius. It is one of those adjustments of the parts which virtually limit each other, and which have to be determined by experiment or practice to ascertain accurately which way offers the greatest advantages and fewest disadvantages, but is a good and efficient wheel made either way.

Cross-int. 37. Which form of crown, the horizontal between the outer and inner edges of the floats, or that which curves downward within the same limits, offers the least resistance to the water in flowing through the floats, the water entering the wheel in both cases horizontally, under a head, and all other things being equal?

Ans. As I understand the question, the action inquired of is limited to the space in the wheel between the floats, and without reference to any other action of the wheel; and with this understanding I answer that the downward curve of the crown within that space would produce a slightly increased resistance to the water flowing through it, as compared to the straight crown, but the resistance of the water flowing through the wheel, to which I before referred in speaking of the purpose of the curvature, lies mainly without that space and mainly within the circumference of the inner edges of the floats.

Cross-int. 38. Does not the tendency of water entering the
284 wheel on the periphery to discharge downwards when the crown is horizontal, increase with the height of the float?

Ans. I do not see that it does materially. If I understand the question correctly, gravity of the water, which I suppose to be the thing supposed by the question, has little or nothing to do with a turbine which acts in a case which is solidly filled with water, or perhaps submerged in it.

Cross-int. 39. How long has the upper crown of a centre-vent turbine performed the "object or office" described by you in your answer to int. 14, to wit, "to form a support for the buckets or floats to form the upper side of the passage through which the water flows, and to connect the wheel with the shaft which supports it in position by any suitable connecting parts"?

Ans. I cannot tell. The earliest notice of it that I now recall as a definite instance is the wheel of Boyden, which was patented in 1853; whether that construction was devised by others before that time or not I do not know. I think perhaps the wheel of Thompson in Scotland, which is the subject of an English patent, may be prior to this, but I have no means at hand to verify the date.

Cross-int. 40. Can a wheel which gives better results than a Jonval wheel of proper proportions, of the same size, be a Jonval wheel of defective proportions, all other things being equal?

Ans. I can't tell upon the conditions of the question.

Cross-int. 41. Can a Jonval wheel of defective proportions give better results than a Jonval wheel of proper proportions, all other things being equal?

Ans. I think not; I think the question answers itself substantially.

Cross-int. 42. In what manner do you understand the water was conducted into the "Stowe wheels," so called, in this case? I mean the 1837, 1841, and 1850 wheels, as described by the witnesses.

Ans. I understand it was by means of a long open spout leading from the flume to the wheel that is open at the top, the outside of the spout, or that side farthest from the centre of the wheel, was just tangent to the circumference of the floats of the wheel, and that the wheel stood in the open air, and that the water impinged against only one side of
285 the wheel; that the water was kept up to the wheel a short distance by means of a short curb, which was a continuation of the outer side of the spout, and the water discharged or escaped from the wheel, some upwards, some inward, and some downwards where the under side was not occupied by the floor of the trough, but that the main part of the water escaped outward beyond the end of the curb.

Cross-int. 43. And is your testimony as an expert based upon such understanding?

Ans. It is partly, but not entirely; it is also based upon other considerations, which I have stated in my direct testimony.

Cross-int. 44. Your testimony as an expert assumes your understanding of the method by which the water was introduced into the wheels to be correct, does it not?

Ans. It does.

Cross-int. 45. Do such wheels constitute individually water wheels, the floats of which have a discharge line extending from the crown at the inner edge to the lower outer edge of the wheel?

Ans. They do not in any sense in which such a term is applicable to a turbine wheel.

Cross-int. 46. The question uses the term "water wheel," and not a "turbine wheel"; with that understanding please answer the question.

Ans. It is equally true with this modification of the question, in my judgment.

Cross-int. 47. Do such wheels have floats, the discharge lines of which extend along their entire inner and under sides?

Ans. They do not.

Cross-int. 48. Do they have crowns extending above the floats, from their inner edges to their outer edges?

Ans. As I understand the description given in Stowe's testimony, the rim to which the floats were attached might perhaps be called a crown so far as it supported the floats, though not a such a device in its action in relation to the water as has been called a crown in this examination.

Cross-int. 49. Wherein does the action of the crown in such Stowe wheels differ in its action from such a device as has been called a crown in this examination?

286 Ans. It differs in relation to every property that the Stowe wheel has, and especially to every part in which this wheel differs from a turbine as to its mode of operation. The crown of a turbine forms the upper side of a passage for the water as it flows through the wheel, and acts upon the water entirely around the circumference in a solid column, which is an action that is not in this wheel at all. Whatever water in this wheel flows inward is only that which splashes in, owing to the dashing of the water against the floats in the air, and the main portion of the discharge of the water in the Stowe wheel is outward, by the same edge of the bucket by which the water is received; and the floats which are supported by this rim or crown in the Stowe wheel are clumsy blocks of wood, against the surface of which the stream of water impinges against one side of the wheel only, and in no wise adapted to the flow of the water between them towards the centre, to produce the effect of rotating the wheel; but on the contrary, the water is intended to flow around the circumference a short distance, carrying the wheel with it by its impulse, and leaving the wheel on the outside beyond the end of the spout which leads the water to it. It has all the differences from the construction shown in the turbine wheel that I have before enumerated at some length in my direct examination.

Cross-int. 50. If it should be held in this case on the testimony of the witnesses that the spout conducting the water to the Stowe wheel was covered, and that the water, with all the pressure due to a considerable head, entered the wheel on its periphery, and passed through the floats into the interior of the wheel, occupying all the space between the under side of the crown and the inner edge of the band for its discharge, and discharging wholly inward and downward, and not outward, would the floats of the Stowe wheel, under such a posture of facts, have discharge lines extending from the crown at their inner edge to their lower outer edge?

Ans. I cannot tell, because I do not understand by the terms of the question whether the wheel works in such an enclosure as amounts to a case for the wheel; and I also do not understand how a wheel constructed as I understand the question to assume can have its discharge inward and downward. At any rate, this description of a wheel is very different from the three wheels in question, which I understand Stowe claims to have made in 1837, 1841 and 1850.

287 Cross-int. 51. The question assumes that the "enclosure" caused all the water to discharge inward and downward, and not outward, and in discharging, to occupy all the space between the under

side of the crown and the inner edge of the band. With this understanding will you please answer the question?

Ans. I cannot answer it, because I do not understand what the structure would be by the description which is assumed in the question.

Cross-int. 52. The structure assumed is one which will make the water act as stated. Can you now answer the question?

Ans. I do not see that I can, because the question requires some condition of things which will enable the wheel to act as stated in the question, and what that is or may be I cannot tell. I know what the conditions are, which are present in a turbine in which the water flows inward, as stated, but whether a wheel can be made with the water all flowing inward, and without an entire case, I cannot tell. But I am clearly of the opinion that when it does so flow inward, as suggested by the question, it acts in a substantially different way from what I understand it to have acted in Stowe's wheels aforementioned.

Cross-int. 53. Well, when it "does so flow inward, as suggested by the question," and discharges inwardly and downwardly all the way from the under side of the crown to the inner side of the band, does the float whose inner edge extends from the under edge of the crown downward and outward to the band have a discharge line from crown to band?

Ans. I think it would, as I understand the conditions of the question, and limited to this property only.

Cross int. 54. Will you now look at defendant's Exhibit 3, purporting to represent one of the Stowe wheels, and state whether it contains a combination of crown, band and floats, the floats having their discharge line from the crown at the inner edge to their lower outer edge; and if such wheel does not contain the parts named, will you state what alterations are necessary to make it contain the same?

Ans. I cannot tell, because there is not enough of the exhibit itself to determine whether the water flows past it or through it. In
288 order to make the water flow through it, there must be a case to the wheel, and proper means for directing the watea on to the wheel. Assuming that to be the case, then I think there would be a combination, in a clumsy way, of a crown with the floats, with a discharge line for the same extending from the crown to the inside of the band; but if the water were to be applied to such a wheel by means of a spout applied to one side of it, in the manner which I understand to be described by Stowe, with the discharge of water mainly outward from the periphery of the wheel, I do not think the combination recited in the question would be substantially embodied by it.

WM. C. HIBBARD.

Attest:

JOHN G. STETSON,
Examiner.

Deposition of Hervey Waters.

BOSTON, *Dec.* 18, 1875.

Direct examination by J. S. ABBOTT, Esq., of counsel for complainant.

Int. 1. Please state your name, age, residence and occupation.

Ans. Hervey Waters; seventy-one; Boston, Mass.; machinist and expert in patent causes.

Int. 2. For how long a time have you testified as an expert in patent cases, and whether frequently or otherwise?

A. For a period of some thirty years, as well as I remember, and frequently during that period, with the exception of two years.

Int. 3. Please state what practical experience, if any, you have had in regard to turbine water wheels.

Ans. I have had some experience in the practical use of turbines, and to some extent in their construction, especially in regard to a contrivance of my own for overcoming the difficulty arising from the use of the gate in the common French turbine; and in the course of this contrivance I have had occasion to investigate somewhat thoroughly the mode of operation of this class of wheels as embodied in the invention of Fourneyron.

Int. 4. Have you carefully examined complainant's Exhibit B, being copy of reissued Letters Patent No. 5154, dated Nov. 19, 1872, and do you understand the same?

289 Ans. I have, and understand the contrivances described in it.

Int. 5. Have you examined Exhibit D, being a thirty-inch wheel introduced into this case, and illustrated in cuts No. 2 and No. 3, on page 4 of complainant's Exhibit O; and do you understand the same, and the principle, construction and operation of that wheel?

Ans. I have examined all the exhibits inquired of, and understand the operation of the water wheel Exhibit D, as explained and illustrated by the cuts in Exhibit O.

Int. 6. Have you examined defendant's Exhibit No. 10, being letters patent granted Abel Greenleaf, dated May 16, 1854, No. 10916, and do you understand the same?

Ans. I have, and I do.

Int. 7. Have you also examined letters patent granted Waldo Whitney, dated May 10, 1864, No. 42708, and the wheel complainant's Exhibit T, admitted to have been made by said Whitney, and as being a specimen of his patented wheel, and defendant's Exhibits 2, 3, and 7, and Exhibit Sketch of 1837 Wheel, and the testimony of John L. Stowe in relation to wheels claimed to have been made by him in 1837, 1841, and 1850, and do you understand the same?

Ans. I have, and I understand the wheels represented by the exhibits inquired of, with the patents included.

Int. 8. I now call your attention to defendant's wheel referred to in your fifth answer, and to the reissued letters patent No. 5154 referred to in your fourth answer. Please state whether and wherein said defendant's wheel includes or embraces the invention described in said reissued letters patent, and referred to in the claims therein, and give your reasons for the opinions expressed.

Ans. In this patent to Swain there are in all eleven clauses of claims, but as I understand this controversy there is no allegation that what is referred to in the fourth, sixth, seventh, eighth, ninth, tenth and eleven' clauses of the claims is contained in the defendant's wheel Exhibit D, and I therefore eliminate from the question all that is referred to in those claims, with the exception of the guides *e*, which make a part of some of the combinations referred to, and which with other parts go to form the pitch or guide of the water on to the wheel. What I un-

290 derstand to be referred to in the first clause of the claim of the Swain patent, I find in defendant's wheel Exhibit D. I say the same in regard to the second clause of the claim, and the same in regard to the third clause, and also the same in regard to the fifth clause. Among other things set forth in this patent I find as follows:

"This invention relates particularly to the improved construction, combination and arrangement of different parts of a water wheel, in such a manner as to effectively combine in one wheel the elements of an inward flow turbine and a downward flow turbine, together with an

effective direction of the water at any opening of the gate, giving increased capacity, compactness, efficiency and economy to the wheel."

From this statement I understand that the invention relates to an inward flow turbine and a downward flow turbine; so that it always relates to a turbine wheel proper, having the characteristics of the Fourneyron turbine, but receiving the water upon the periphery of the wheel instead of receiving the water upon the interior of the wheel, as in the Fourneyron proper; but like the Fourneyron proper, the effect of the water is obtained: First, by its action upon the wheel in the direction caused by the guides which lead the water to the wheel, and by the momentum of the water acting against the floats as it is projected through the guides by the force of the head resting upon it. Second, by the action of the water within the wheel, due to the discharge openings of the wheel, usually called reaction, although the term is of doubtful accuracy. Further on in the patent, and after describing to a considerable extent the construction of the wheel, the patent says:

"By this construction and arrangement of the crown and floats we combine an inward flow turbine and a downward flow turbine effectively in one wheel, which gives greater area of discharge nearer the centre of the wheel, the floats having a discharge line equal to the height of the float in the well-known Fourneyron or Warren wheels, and that due to the width of the float in a radial direction, as in the Jonval turbine."

Now the general character of the invention described in this patent, so far as is in controversy in this case, is well stated in the last quotation from the patent; but it can be well stated otherwise, as follows:

291 by this construction and arrangement of the crown and floats we construct an inward flow turbine, having the length of its discharging apertures much greater than the length of the receiving apertures, whereby we obtain a turbine wheel capable of using effectively a given quantity of water, so as to obtain all the benefits of the Fourneyron proper, but of a less diameter than would be required for using the same quantity of water effectively, in any wheel known to the public prior to the date of this invention. Now, in consequence of this invention, by which the diameter of the wheels may be reduced, this class of wheels can be furnished cheaper than those which preceded it, because the wheel being less, less material and less labor is necessary to produce it, and the effect of this goes to all the surrounding parts of the wheel, such as the gate or guide pitch, the flume or scroll which leads the water to the pitch; so also of the shaft and gears, both of which may be less, because the wheel being small in diameter would make more revolutions with the same head of water. I have said that in this invention the delivering aperture is longer than the receiving aperture, and that this is important because wheels could be made smaller in diameter than they otherwise could be and produce a given effect; and in order to understand this it will be proper to take along the fact that no such lengthening is of importance in the Fourneyron turbine proper, because that there the discharging orifices are upon the periphery of the wheel, and the receiving orifices in the interior of the wheel, so that there is no difficulty in getting a proper proportion between the receiving orifices and the delivering orifices of the passages for the water through the wheel; but when this is reversed, and the receiving orifices are upon the periphery of the wheel, and a proper direction is given to the discharging orifices, a suitable proportion between the receiving and discharging orifices cannot be obtained unless those discharging orifices can be made longer than the receiving orifices, so as to get a greater area in cross-section of the delivering orifices than would be obtained if

the same were shorter. This is accomplished in this contrivance of Swain by leaving out the lower rim of the wheel represented by the model complainant's Exhibit G, and also the inner rim, represented by the model complainant's Exhibit H, and swinging the delivering orifices in a curve from the lower part of the buckets at the lower rim of
292 Exhibit G around to the crown of the wheel, so that the water is discharged from the delivering orifices in a long, curved sheet, from the bottom of the buckets at the periphery of the wheel to the top of the buckets at the crown of the wheel. That such is the sheet delivered from the orifices of this contrivance of Swain may readily be seen upon an examination of the model complainant's Exhibit E, where it will be observed that the long edge of the float at the delivering orifice is in a plane with the axis of the wheel, or nearly so; and if the length of this edge of the float be measured it will be found to be in the neighborhood of seven-eighths of an inch in this model, while the receiving orifices are about half an inch or a little more: and the area of the cross-section at the receiving end of those tubes, when compared with the area of the delivering cross-section, will not vary much from the ratio of twelve to seven. Now, without this curved form of the delivering aperture, no such proportion could be obtained, either with a horizontal aperture or with a perpendicular aperture. The breadth of the rim or crown from the inner face of the buckets to the outer face of the buckets being the same as in this model, and the height of the buckets from bottom to top being the same as in this model, in the one case the receiving openings at the periphery, and the discharge openings in the inside, would be as twelve to four, or thereabouts, and in the other it would be as twelve to four and a half, or thereabouts. Going now to the defendant's wheel, complainant's Exhibit D, I find the same thing is accomplished there by the same means. In that wheel the water is discharged in a curved sheet longer than the height of the bucket or the breadth of the bucket substantially as it is in the complainant's wheel, but the portion above the curve at the top occupies a greater length of the discharge opening than is done in the complainant's wheel described in the patent. The perpendicular line of edge of the buckets and also the perpendicular line of the sheet of water discharged is longer in proportion than it is in the wheels specifically described and represented in the drawings of complainant's patent; and insomuch as it differs in this respect from complainant's patent it is no better, but rather worse, in my judgment. When a wheel like Exhibit D is put into a flume and provided with a pitch such as is repre-
293 sented at No. 3, page four, complainant's Exhibit O, then the mode of operation of the wheel and the pitch is substantially the same as the mode of operation of the wheel and pitch described in the complainant's patent on which this suit is brought; and this, notwithstanding the manner of opening and closing the pitch so as to admit of more or less water, as required, is different specifically from the manner of opening and closing the pitch in the complainant's patent; the one, however, being an equivalent for the other, because the water issues through the pitch substantially the same in one as in the other (everything else being equal), with a force according to the head above the delivering apertures of the pitch.

Adjourned.

BOSTON, *Dec.* 20, 1875.

But in another aspect of this matter the complainant's wheel and the

defendant's wheel are just alike. It is obvious that in the defendant's wheel the lower rim is left entirely out when the same is compared with complainant's Exhibit G, and in that respect it is precisely like the complainant's; and it is obvious that instead of that rim there is a band for strengthening the floats just the same in one wheel as in the other. Now I understand that this band may be dispensed with, without altering in any way the mode of operation of the wheel, the effect of such removal being simply to make the wheel not so strong as with the band. It is also obvious that in the defendant's wheel the buckets are rounded off through ninety degrees of a circle, and in this respect it is just like the complainant's wheel.

Now, both the removal of the lower rim and the rounding of the buckets in this contrivance of Swain are essential to the general result produced by his invention, for the reasons which follow: I have already said that in the Fourneyron turbine proper there was no difficulty in making the discharge apertures of the wheel as they should be made, because the discharge was on the periphery of the wheel; and it is also true that in that wheel there is no difficulty in clearing the water away from the wheel, for the same reason; the difficulty with that wheel is in bringing the water to it through a suitable pitch, so as to give a proper direction to the water to strike the floats as it should do. But when the water is pitched upon the periphery of the wheel, as it is in this
294 wheel of Swain's, then the difficulty is in discharging the water from the wheel, because it is discharged inwardly instead of outwardly. It will be obvious, when considering the vertical cross-section of Swain's wheel, that all the water discharged through it can pass away from the wheel only by going beneath the band at the outer periphery of the buckets, and this will be substantially the case in regard to the buckets, whether the band is there or not. I here produce a drawing representing such a cross-section of the Swain wheel as I have just referred to, and on this drawing at the right hand I have made dotted lines showing substantially how the water will pass through the sluices of the wheel, and down to the bottom line or level of the buckets. From this it is obvious that the passage of water from the wheel will be in an annular column, the outer line of which will be at *a* and the inner at *b*, constituting a hollow cylinder. Upon the left-hand side of this drawing I have made a dotted line representing an extension of the perpendicular portion at the upper part of Swain's buckets down to the bottom line of the wheel. Now it is obvious that if the lower rim of the wheel were retained as in complainant's Exhibit G, then the water could escape from the wheel only in an annulus of the breadth or thickness extending from the dotted line at *a* to where the horizontal line strikes the hub of the wheel at *b*, which would be considerably less than one-half of the area of discharge in Swain's contrivance. Taking now the other wheel represented by complainant's Exhibit H, it will be obvious from the drawing that the discharging column will be in the form of an annulus of a thickness equal to the distance between *x* and *y*, in the left-hand side of the drawing, which, it will be seen, is very much less than the distance from *x* to *b*, which is the discharging column of Swain's wheel when the band is not used; and when it is used it is from the inside of the band to b. Moreover, it will be seen that if a wheel were constructed like defendant's Exhibit No. 13, where the discharge lines of the buckets make substantially a right angle at the meeting of the perpendicular and horizontal lines, then it would not discharge the water as Swain's wheel does, for the reason that the buckets are not rounded off, as they

are in Swain's wheel. There are other reasons why this wheel De-
295 fendant's Exhibit 13 is not a good one, which I do not deem it important to refer to for the purposes of this case. On referring again to this drawing, it will be seen that notwithstanding the lower rim were removed, all the water that is discharged inwardly through the perpendicular portions of the buckets would have to pass out in a discharging column of just the same size that it would if the rim were not taken away, which is the distance from *a* to *b*; and this is because no water can pass away from the wheel between the buckets, as that space is always filled with the water passing through the sluices of the wheel from the outside. But when the corners are rounded off, as in this drawing, then it allows the water passing from what would be otherwise the vertical face of the buckets, to pass farther out towards the periphery of the wheel, and consequently through an increased area of space, because the area of discharge increases all the way from the point c downward out to the periphery of the wheel, as will be readily seen on reference to the drawing. (The drawing referred to is marked Complainant's Exhibit D', J. G. S., Examiner.) I have said that an important feature of Swain's invention consisted in increasing the length of the discharging apertures of the wheel. Now it is obvious that the length of the discharging apertures in a wheel of the same diameter as Swain's might be increased by increasing the perpendicular line of the buckets from the bottom of the wheel, say, up to a point where the dotted line *d* meets the horizontal line *e*, *f*, which represents the crown or upper plate of the wheel. But it will be obvious that the entering aperture of the bucket will be increased also up to the point *e*, which would be objectionable; but this is not the main difficulty; the main difficulty consists in the fact that all the water which passed through those lengthened sluices would have to be driven out through the annulus extending from *a* to *b*, and this can only be done by a percentage of the effective power of the water, when considered theoretically, and therefore so much of that effective power would be subtracted from the ultimate effect of the water acting upon the wheel; and this would be true if the lower rim were retained or not, if the buckets extended down in the bottom of the wheel as at *a*. Now the perpendicular height of the buckets is greater proportionately in the defendant's wheel than
296 in the complainant's wheel, as I have before stated in this answer; but this, as I before stated, is a disadvantage in that wheel, because in that wheel all the water that passes through the perpendicular portion of the buckets has to pass down in a cylindrical annulus to the point where the buckets begin to curve, which is indicated at *c*, in this drawing; but from that point downward the defendant's wheel has all the advantages of the complainant's contrivance, as will be obvious on examination. So in the defendant's wheel, the crown extends horizontally to a point a little beyond where the line *a*, *d*, passes the line *e*, *f*, while in the complainant's machine, as represented in this drawing and in the patent, the curve downward of the crown commences much nearer the periphery of the wheel. But it is obvious that in the defendant's wheel this does not make any material difference to the advantage of that wheel, because that all the water that passes out of the wheel between the point *c*, from where the line *e*, *f*, crosses the line *c*, *d*, has to pass out through an annulus, one wall of which is represented by the line from *a* to *b*, while the portion from *c* to *x*, which is considerably less than from *c* to *d*, has a much larger annulus of discharge, because the walls of that annulus extend from *a* to *x*, which is a considerably greater distance than from *a* to *b*, while the diameter of the annulus, *a*, *x*, is considerably

larger than the diameter of the annulus *a*, *b*; so that, in my judgment, the defendant's wheel would work better if the curve of the crown plate were brought down as it is in the complainant's wheel, represented by the line from *g* to *h*.

Int. 9. I now call your attention to Defendant's Exhibit No. 10, being letters patent No. 10,916, granted to Abel Greenleaf, and which in your sixth answer you say you have examined and understand. Please state whether any differences exist in that patent as compared with the Swain reissue, complainant's Exhibit B; and if differences exist, describe them, and state whether they are substantial and material.

Ans. There are great differences between the Greenleaf wheel and the Swain wheel. One great and important difference between them consists in the fact that in this region where water power is of about the same value as steam power, the Swain wheel is a good one, and
297 the Greenleaf is good for nothing. Another difference consists in the fact that the Swain wheel acts mostly by the impinging force of the water, while the Greenleaf wheel acts mostly by the reaction of the water, as that term is generally employed; the Greenleaf wheel being, in this respect, but a little more than the old Barker-mill, where the water was admitted into the wheel axially, and passed out through two arms horizontally, and was discharged through two holes, a cross-section of each being in a plane of the axis of the wheel, so that the water spouted out of the wheel in the tangent to a circle. There is one thing in the Greenleaf wheel which is like a corresponding thing in the Swain wheel, and that is the cross-section of the discharge aperture of the wheel; but everywhere else the comparison fails, so far as anything is concerned which is referred to in the first, second, third, and fifth clauses of the contrivances of Swain, described in his patent. It will be seen that in the Greenleaf contrivance the buckets or guides for the water, which constitute the sluices of the wheel, when starting at a point at the outlet of the sluices, curve inward, while in the Swain contrivance they curve outward. This is a very important difference, because it is by their curving outward in the Swain wheel that the projectile force of the water is enabled to act directly upon the buckets to propel the wheel around. There are, in this Greenleaf wheel, small radial floats for the purpose of receiving the impinging force of the water, but in practice they amount to but very little, because they are not reached at all for any practical purpose by the water, as it is projected through the gate, until the gate is nearly or quite wide open. And this is because of the insufficiency of the pitch or guide which directs the water to the wheel. If reference be made to Fig. 7 of the drawings of the Greenleaf patent, it will be seen that a concentric line represents the outer periphery of the wheel, and that outside of that is a helical line representing the surface of the outer wall of the pitch, which guides the water to the wheel, and that this helical line is everywhere at a considerable distance from the wheel, but is at a greater distance than anywhere else at the throat, where the water is admitted into the scroll passage. Now, inasmuch as these radial floats do not extend beyond the periphery of the wheel, they will not be touched at all by any
298 water passing through that scroll so long as it runs outside of the periphery of the wheel; and if reference be again made to the drawing, it will be seen that the dotted line *m* represents the gate as half open or thereabouts, in which position the face of that gate is nearly parallel to the dark line upon the left hand of *m*, which represents a portion of the flume, and which constitutes one side of the pitch or sluice through which the water passes, while the gate constitutes the other

side in that direction. Now the course which a jet of water will take when forced through this passage by its head will be in a line parallel to a medium line between these two faces, so that it will impinge directly upon the outer wall of the scroll, and will not touch the wheel at all at this point, but will follow the outer curve of the wall until it reaches a narrower space in the scroll, and has its volume enlarged by a decreased motion, when it will finally reach the floats, but without any such effect as would be produced if it impinged directly upon the floats where it has its greatest motion, which is at the throat of the gate, as is done in Swain's contrivance and in the contrivance of the defendants. But in the use of this wheel, and in order to get from it any considerable power, this scroll will be full of water whether the gate be fully wide open or not, and when it is full of water and the gate not fully open, the water will flow much slower in every part of the scroll than it will flow directly at the opening of the gate, because the passage way for the water after it leaves the gate will be larger than it is through the gate; and just as much as it is larger, the water must run slower, as is obvious. And, inasmuch as a portion of the water passes out of the scroll and through the wheel at several points between where the scroll is widest and where it is narrowest, so that all that passes through the gate passes through the wheel, at or before the time it reaches the smallest cross-section of the scroll, it is obvious that at no point in the scroll will the water move as fast as at the passage in the gate; and therefore very little effect will be produced upon the floats by the impinging force of the water. Moreover, if this Greenleaf wheel were furnished with a pitch just the same as the pitch described in the Swain patent, then it wouldn't work well, because it is important in the turbine wheel that the passage of the water through the sluices of
299 the wheel should be by such easy curves as to have the water glide through those passages without forming eddies, which would not be the case in the Greenleaf wheel, but which is the case in the Swain wheel. And besides, this Greenleaf wheel is represented as having four buckets only, and therefore four discharging apertures in the whole circumference of the wheel; and it cannot well have more than these, and be constructed to work as described in the patent. Now in a wheel constructed according to the Swain patent, and as represented by Complainant's Exhibit E, which is something less in diameter than the wheel represented by Fig. 7, there are twenty-three buckets, constituting twenty-three sluices, which is about six times as many as can be well got into the Greenleaf wheel, if constructed as represented in this patent.

Int. 10. Please refer to letters patent granted Waldo Whitney, No. 42,708, and the wheel Exhibit T, admitted to have been made by said Whitney, and to be a specimen of his patented wheel, and state what differences, if any, exist between the same and the Swain reissue, Complainant's Exhibit B; also state whether such differences, in your opinion, are substantial and material, and the grounds of your opinion.

Adjourned.

BOSTON, *Dec.* 21, 1875.

Ans. The patent inquired of describes a wheel substantially like Complainant's Exhibit T, I believe. The wheel Exhibit T differs materially and substantially from the wheel described in the Swain patent, on which this suit is brought. Strictly speaking, there is no inward discharge from the wheel Exhibit T. I mean by this there is no perpendicular line of edge upon the buckets which go to form the sluices of

the wheel. There is a perpendicular line of about three inches on this wheel at that portion of the buckets nearest the axis of the wheel, but there is no opening there for the discharge of the water, as will be seen on an examination of the wheel. I have drawn on Complainant's Exhibit D′ a dotted line extending from 1 to 2, which line represents the lower edge of the buckets in Exhibit T, and also the lower line of the discharge openings substantially, which openings terminate at 2. The perpendicular part of the bucket is from 2 to 3 substantially, but there are no discharge openings above 2. The upper portion of the
300 bucket extends from 3 to 4, and the distance on the perpendicular line from 1 to 4 represents the whole height of the buckets, and the distance from 4 to 5 represents the height of the openings upon the periphery of the wheel, which constitute the receiving apertures of the wheel. There are in this wheel ten of these openings, and accordingly ten discharging apertures. Now the first noticeable difference to which I will refer is in the relative length of the discharge openings in this Exhibit T when compared with complainant's wheel of a similar size. It will be seen on reference to the sketch that the distance from 1 to 2 is about the same as the distance upon the edge of the buckets in complainant's wheel, while the height of Exhibit T is full twice as great as the height of complainant's wheel, and if reference be made to Exhibit T and to Complainant's Model E, it will be seen that there are more than twice as many sluices in complainant's wheel as there are in the wheel Exhibit T, so that if the discharging orifices were of equal size in each, and the water were used with the same economy in each, then a complainant's wheel of the diameter of Exhibit T would do twice as much work as Exhibit T can, and something more. I have said in the course of this examination that the sluices in the Complainant's Exhibit E had their receiving orifices and their discharging orifices in proportional area of cross-section as about twelve to seven. Going now to Exhibit T, and making the same comparison, I find the relation will be as sixty-one to sixteen nearly; this difference of itself is enough to condemn the wheel for the purposes of procuring any such percentage of the power of the water as is required in this section of the country at the present day. Comparing now the mode of discharging the water from the wheel in Exhibit T with the complainant's wheel, it will be seen, on reference to the drawing and the wheel itself, that the relative height of perpendicular line of discharge, when reckoned from the bottom of the wheel upward, varies so much as to show that the two wheels cannot act alike. In Exhibit T the actual height from the bottom of the lower rim upward to the top of the discharge line will not vary much from three inches, and the whole perpendicular line of the wheel at the receiving orifices is about twelve inches, so that the uprise of the discharge openings is only about one-fourth of the
301 whole height of the wheel, while in the complainant's wheel it is of the whole sometimes, and always nearly of the whole height of the wheel; and in defendant's wheel it is the whole height of the wheel. There is another difference between the wheel Exhibit T and complainant's wheel as described in the patent and represented by complainant's Exhibit E. In the complainant's wheel, the discharge orifices are in cross-section, a parallelogram; in the wheel Exhibit T they are very nearly a triangle, so that they are or must be constructed differently, or else this difference would not exist. Referring now to the sketch Exhibit D′, it will be observed that the discharging orifices in Exhibit T, everything else being equal, will extend much farther from the periphery of the wheel towards its axis than they do in complainant's wheel, so

that all that portion of the discharging orifice in Exhibit T which extends beyond the perpendicular portion of complainant's buckets, as shown at 6, will have a much smaller average motion when compared with the periphery of the wheel than any portion of the buckets would have in complainant's wheel, so that when the wheel outside of that line had a motion properly proportioned to the head of water, all within that line would run too slow, and consequently the water would be forced backward as it was discharged from the wheel, instead of falling dead, as it should do, from the wheel; and when the water is so forced backward, it is evident that the power has not all been taken out of it. Or, stated in a homely manner, it is always evidence of a wheel's bad performance when the water squirts away from it, because that squirting is at the expense of the power of the water which should have been taken out of it in the wheel.

Int. 11. I now call your attention to defendants' Exhibits 2, 3, and 7, and (Exhibit sketch of 1837 wheel), and the testimony of John L. Stowe in relation to the wheels claimed to have been made by him in 1837, 1841, and 1850, all of which are referred to in the seventh interrogatory and answer; and I request you to state wherein the said wheels which Stowe says he made in 1837, 1841, and 1850, as shown and illustrated by said exhibits, and as described by him, differ from the complainant's said patented turbine. If such differences exist, state whether they are, in your opinion, substantial and material, with the reasons for your opinion.

302 Ans. This Stowe wheel differs from the Swain wheel in the fact that it is not a turbine wheel at all, according to the signification of that term in the Swain patent. This wheel is nothing more than a common tub wheel, with the water pitched upon the periphery, instead of being pitched in over the floats, as usually practised in the old tub wheel. Moreover, the Stowe wheel has but one spout or guide through which the water is pitched upon the wheel, which spout, according to Stowe's testimony, taken in connection with (Exhibit sketch of 1837 wheel), covered only about one-twelfth of the periphery of the wheel, instead of covering the whole periphery with the spouts or guides, as is done in the Swain contrivance. According to (Exhibit sketch of 1837 wheel) the spout covers nearly one-sixth of the periphery of the wheel, but this does not agree with the testimony of Stowe, as it appears upon the record, and as appears from the model defendant's Exhibit 2, E. E. M., Commissioner. Stowe, in his testimony, says that the wheel, of which this is a sketch, was seven feet in diameter, and he also says that the spout was twelve inches by six. Now, according to the sketch and according to the model, the distance from the band to the crown, in this instance, was about twelve inches, which corresponds to the breadth of the spout in a perpendicular direction, and if this were so, then six inches would be the horizontal breadth of the spout, which, according to the scale of the sketch, would be half an inch upon the sketch; and I have drawn there a dark lead line representing what would be the inside of the spout according to his testimony. I assume this as the scale of the sketch because Stowe says the wheel was seven feet in diameter, and this sketch shows the wheel seven inches in diameter, consequently the scale would be one to twelve, and therefore the half inch would represent six inches. Taking now this sketch and measuring about the edge of the float, I find the distance something more than two feet, and I find the opening, from bucket to bucket, of what Stowe seems to understand to be the delivering orifice of the wheel, nine inches, and in some parts considerably more than nine inches, which

would give as the area of each of the delivering apertures of this wheel, according to Stowe, something more than two hundred and sixteen square inches, while the area of cross-section of the spout would
303 be only seventy-two inches. From this it is clear that nothing more than the direct action of the water could be obtained in this Stowe wheel, and only a very poor result at that, because the water in striking the float would break in all directions through the two hundred and sixteen inches of area after it struck the float, and just so much of the force of the water as remained in it and made a jet through that opening would be lost out from the impinging force of the water. It is undoubtedly true that a small increment of power would be obtained from the broken water which might gravitate upon the spoon-shaped bottom of the buckets, but it would be only the gravity of that broken water without any assistance from the head of water in the flume, which is the only source of the reactive power in the turbine proper, where the buckets are perpendicular, and is nearly the only source of reactive power in the Swain turbine. Now I understand that all these Stowe wheels are substantially the same as the first one he says he built in 1837, all having the same general character, and none of them good for anything at the present day in this region. The turbine wheel here under consideration, as described by Swain in the patent upon which this suit is brought, is always submerged when properly used in order to get the whole effective power of the head of the water; but Stowe says he didn't submerge his wheel, and if he had submerged it, probably not a quarter of the power could have been got out of the water with it which could be got out of it when used as he says Fisher used it.

Int. 12. Please examine complainant's Exhibits I, R, and S, and compare the same with complainant's Exhibits E, B, and W, and state whether or not the several wheels, Exhibits I, R, and S, are in character, principle, and operation substantially like complainant's Exhibit E; and also substantially like the wheel shown in the drawing, complainant's Exhibit W, and substantially like the wheel described in the Swain reissue, complainant's Exhibit B, and illustrated by the drawings connected therewith.

Ans. They are, to all branches of the question. There are some slight differences, but nothing going to change the type or general character of the wheels. Exhibit I, for instance, has no band on the buckets; all the others have a band; so, also, Exhibit I has an
304 absolutely horizontal crown, and Exhibit S has a crown nearly absolutely horizontal, and all the others curve downward slightly, some a little more than the others.

Int. 13. Is there any substantial or material difference in wheels constructed in conformity to the said Swain reissued patent when the crown of the wheel covering the buckets from their outer to their inner edges is horizontal instead of curved, as shown in complainant's Exhibits W and E?

Ans. No. I have already stated this in substance in my last preceding answer.

No cross-examination.

HERVEY WATERS.

Attest:

JOHN G. STETSON,
Examiner.

FURTHER EVIDENCE FOR DEFENDANT.

Taken pursuant to the sixty-seventh rule of the Supreme Court of the United States, in equity, as amended, before me.

JOHN G. STETSON,
Examiner.

BOSTON, *Feb.* 28, 1876.

Present, John S. Abbott, esq., and H. W. Boardman, esq., of counsel for complainants; Causten Browne, esq., and C. E. Mitchell, esq., of counsel for defendant.

Deposition of Henry B. Renwick (recalled).

Direct examination by CAUSTEN BROWNE, Esq., of counsel for defendant:

Int. 1. At page 290 of the record, Mr. Waters says that he understands the effect of the water in the Swain wheel as described in the patent in suit to be obtained, "first, by its action upon the wheel
305 in the direction caused by the guides which lead the water to the wheel, and by the momentum of the water acting against the floats as it is projected through the guides by the force of the head resting upon it; second, by the action of the water within the wheel, due to the discharge openings of the wheel, usually called reaction, although the term is of doubtful accuracy." Will you state whether, in your judgment, the view here expressed by Mr. Waters is correct, and if not, why not? And in connection with this question refer to his statement made upon page 301 of the printed record, in reference to the falling of the water "dead, as it should do from the wheel."

(Objected to, first, because it is not competent or allowable to introduce the proposed testimony in this stage of the case, that is, after the complainant's testimony in rebuttal; and, second, because the witness has not been shown to be an expert competent to answer the inquiry.)

Ans. I have studied considerably on the action of turbine wheels and how the water acted upon them, having read various books on the subject, commencing with the first turbine nearly thirty years ago, and I understand the last quoted statement of Mr. Waters that the water should fall dead to be theoretically correct. If a centre discharge turbine were held at rest with the water passing through it, the water would spout out in a direction opposite to that of the motion of the wheel with a velocity due to the head; but if the wheel is permitted to turn with that same velocity, then the water would fall dead—would not be projected backward from the buckets, and the wheel would run with the best possible effect, because it works exactly like a Barker's mill, and derives its power from what is commonly called reaction, or, more properly speaking, unbalanced pressure. What I mean by unbalanced pressure is this: Suppose a box a foot long and an inch square in the inside were stopped up at both ends, and that an India-rubber pipe were applied at the middle of it, say an inch and a half in diameter, and this pipe (say four or five feet long) were connected with a reservoir of water which could give a pressure of ten pounds to the square inch on the inside of the box, then the box would stand still, because the pressure on two sides of the box would be balanced by the pressure on the two other sides, and the pressure of ten pounds on the inside of
306 one end of the box would be balanced by the pressure of ten pounds on the other end. Now if one end of this box be knocked out, the

pipe will still keep up the pressure within the box; and there will be a pressure of ten pounds on the inside of that end of the box which is left in place, and the box will move forward in the direction of the end that is still left in, with a force proportioned to the pressure of ten pounds to the inch, and that is (as the box is one inch square) ten pounds, because the pressure on the end left in is no longer balanced. This action of unbalanced pressure is familiarly exemplified in the effect that takes place in the bursting of steam boilers; if a boiler gives out at the bottom, thus leaving an unbalanced pressure on the inside of the top, the boiler goes up into the air; if the boiler gives out at the fire-box end, the boiler travels away from the fire-box, or the place where the fire-box was. Now, the box that I have spoken of, when traveling with the end knocked out, would give the best effect if the water fell dead and was not forced backward upon the open end; and this falling dead of the water determines the proper theoretical action of a turbine wheel, and therefore proves that it acts, as I have no doubt it does, as a reaction wheel, and not by impact of the water, or momentum of the water acting against the floats, except when the gates are so far shut (and they must be very far shut to produce that effect) that the "sluices," as Mr. Waters calls them, or passage ways between the floats, are not filled.

In practice, with a centre discharge wheel, if the water were allowed to fall dead on account of the wheel running with a velocity equal to that with which the water would issue if the wheel was held at rest, then the periphery of the wheel where the water entered would run faster than the water would follow, and of course there could be no such thing as impact or momentum of water acting upon the floats; and those parts of the buckets nearest the periphery would tend to impede the revolution of the wheel. Therefore, in practice, in a centre discharge wheel, the discharging edges of the buckets are never run so fast as the velocity of the water; and if I were going to make a turbine I should so gear it—the machinery which it was to drive—that the outside of the wheel, the outer periphery, would run at the same velocity at
307 which the water would issue from the end of a spout under the head which acts upon the wheel. Now all turbine wheels are not provided with chutes or "pitches," as Mr. Waters calls them, but many of them run in a scroll case; the scroll causing the water to travel around in a vortex so that it strikes the wheel in lines of tangents to the wheel, or nearly so; and to my knowledge many of the wheels which do use pitches or chutes have those pitches or chutes so arranged with reference to the wheel that there is a space between the ends of the pitches or chutes and the outer ends of the buckets of the wheel which some wheel-makers call a vortex chamber. The floats or buckets of turbine wheels are of various sorts of curves in their cross-section, the curves being dictated by the fancy or the peculiar notions of the builder, and in some cases the curves being the result of long calculation; and I have read of the trials of a great many wheels, and their percentage of efficiency in proportion to the water used does not seem to depend much upon the precise curve of the bucket, although if I were building one I should try to get the buckets to such shape, as nearly as possible, as permits the water to flow through the wheel to the point of discharge with a nearly uniform velocity in the line of a stationary radius. Now, taking all these facts into consideration, my belief is that a turbine wheel, so long as the sluices or passages between the buckets are full (which is its proper working condition), acts by reaction or unbalanced pressure, as a Barker's mill does; but at the same time there is an advantage in so forming a part of the float nearest the periphery in a cen-

tre discharge wheel that the wheel will act partly by impact or by momentum of the waters, as Mr. Waters calls it, when the sluices are not filled, so that the wheel may run when the work is nearly all thrown off.

(Complainants' counsel objects to all parts of the foregoing answer which are speculative; also to the first part of the answer down to and including the words "thirty years ago," and to that part of the answer commencing with the words "Now all turbine wheels," and ending with the words "stationary radius," as irresponsive and inadmissible.)

Int. 2. At the foot of page 295 of the printed record, Mr. Waters remarks that the perpendicular height of the buckets is greater pro-
308 portionally in the defendant's wheel than in the complainant's wheel, and says this is a disadvantage in the defendant's wheel, for reasons which he proceeds to state. Will you please say whether you agree with Mr. Waters, and if not, why not, and why his reasons so given are unsatisfactory to you?

(Question objected to for the same reasons as the preceding one.)

Ans. Whether it would be disadvantageous or not would depend upon the extent to which this perpendicular height was carried, and upon the extent to which the water passage, which extends from the inner edges of the buckets to the shaft, was choked up by the hub and by the shaft itself. Now, as I understand it, in the defendant's wheel the shaft is much smaller than it is in the plaintiff's wheel, and the hub is not as large in proportion and does not extend down so far, so that there is considerably more room for the escaping water in the inside of the wheel than there is in the plaintiff's wheel; therefore in the defendant's wheel the increasing of the perpendicular height of the buckets is advantageous (because a wheel of a given size will give out more power), if the height is not increased to such an extent that the water escaping from the inner edges of the buckets cannot pass off readily. It would require very accurate measurement and calculation of the area of discharge aperture of defendant's sluices or, as I call them, passage-ways between the buckets, in order to determine whether his buckets are of too great a perpendicular height or not. Such calculations are usually made by wheel designers, and if the perpendicular height of the bucket is not too high for the free interior space allowed by the small hub and shaft of the defendant's wheel, then the additional perpendicular height of the bucket is an advantage and not a disadvantage. Mr. Waters refers in this connection to the drawing produced by him, but in this drawing he compares the defendant's wheel with the hub and shaft of complainants' wheel.

(The counsel for defendant here called attention to the fact that in Mr. Waters' ninth answer, page 296, he says "There are great differences between the Greenleaf wheel and the Swain wheel. One great and important difference between them consists in the fact that, in this region, where water power is about the same value as steam power, the Swain wheel is a good one, and the Greenleaf is good for nothing";
309 and then proceeds to speak of other differences as he regards them.

It having been agreed that Mr. Waters should be presented for cross examination before defendant's rebuttal, but it appearing to-day that Mr. Waters is unavoidably absent, and the counsel for defendant desiring to avoid delay, and waiving their right to have Mr. Waters recalled, they give notice that if any other differences between the Swain wheel and the Greanleaf wheel shall be hereafter stated by Mr. Waters than those which he explicitly states in his ninth answer after the sentences above quoted they will claim the right to reply; and in view of

the fact that the alleged differences between the Greenleaf wheel and the Swain wheel have not, until Mr. Waters' testimony, been suggested, either by the examination of experts for the plaintiffs or cross-examination of experts for the defendant, proceed now to inquire.)

Int. 3. Will you please examine the answer given by Mr. Waters beginning with the words "Another difference consists," at the foot of page 296, and state wherein, if at all, the positions there taken by Mr. Waters are, in your judgment, erroneous, and why?

(Same objection as before.)

Ans. At the head of page 297, Mr. Waters states that the Swain wheel acts mostly by the impinging force of the water. I have already stated how I believe the Swain wheel and all other turbines act when working as turbines with the gates open; and that is, by reaction. The Greenleaf wheel so acts, and therefore the two wheels are alike in their mode of operation, instead of different. I have now the advantage of seeing a model of that variety of Greenleaf wheel, which I referred to in my former examination, which model has a card marked "No. 1" nailed upon it. This model is a correct representation of the Greenleaf patent, except that it does not show as it ought to those parts of the bucket which I have marked with an R, as making part of all the buckets. I refer to what Mr. Waters calls "radial floats." When these radial floats are all on, the wheel would act by impact if the sluices were not full.

Mr. Waters next says, that there is one thing in the Greenleaf wheel which is like the Swain, namely, the cross-section of the discharge apertures of the wheel; by which, as I understand it, he means that
310 the edges of the buckets at the point of their discharge are of substantially the same shape in the plaintiffs' wheel and in the Greenleaf wheel. I agree with him in this statement entirely; but I disagree with his statement "that everywhere else the comparison fails so far as anything is concerned which is referred to in the first, second, third, and fifth clauses of the contrivances of Swain, described in his patent"; because it is evident from mere inspection of this model No. 1 that it has a crown, that it has a band, and that it has floats or buckets having their discharge line extending from the crown at their inner edge to the lower outer edge of the wheel.

He next says, that in the Greenleaf contrivance "the buckets or guides for the water which constitute the sluices of the wheel, when starting at a point at the outlet of the sluices, curve inward, while in the Swain contrivance they curve outward. This is a very important difference," etc. I understand Mr. Waters to mean by this expression that the buckets in Greenleaf, when starting from their inner edges to go towards the outside of the wheel, are concave towards the shaft; while in the Swain wheel, at the same point, they are convex towards the shaft. I do not regard this as an important difference, but if it be important, then the defendant's wheel is in that respect unlike the plaintiffs'; because at that point in the bucket the curve of the defendant's bucket is substantially like a Greenleaf bucket; i. e. with its concave side towards the shaft, and substantially unlike the plaintiffs', which is at that point convex towards the shaft. If the meeting angle of the radial floats with the curved floats of the Greenleaf turbine were filled by a small block of wood, so that there was a curve there in the bucket instead of a sharp angle, then the buckets of the Greenleaf wheel would, when cut by a plane perpendicular to the axis of the shaft, show cyma-reversa (or a species of ogee) curves, which is the form of defendant's bucket; and they now act as if so formed, except in degree; the difference of the action being that the easy flow of the water is restricted by

the sharpness of the angle before spoken of, while on the contrary the face sides of the buckets of Swain are described as of paraboloidal form.

Mr. Waters next states that by the curving outward of the
311 buckets in the Swain wheel "the projectile force of the water is enabled to act directly upon the bucket to propel the wheel around." And he also states in substance that the radial floats of the Greenleaf wheel are for that very same purpose, but would amount to little, for reasons which he gives, among which are the insufficiency of the guide or pitch of the wheel, and the want of projection of the float beyond the periphery of the wheel. He then makes a long statement as to the action of the scroll in the Greenleaf wheel, which he modifies very much afterwards by stating the fact (which I believe to be true), just below the middle of page 298, that "this scroll will be full of water whether the gate be fully wide open or not." Now as I never heard of a wheel with the floats projecting beyond the periphery of the wheel into the case which surrounds the wheel, it seems to me that that point of the objection has not much force, especially as they do not so project in the plaintiffs' patent. And as the best working of the Greenleaf turbine at half gate is to make the water go slow, and fill the sluices solid, the statement as to the slow movement of the water, near the foot of page 298, seems to me of very little importance, because the water, no matter how slow it travels, must, if it act at all by impact, act by a force proportional to its speed. In the Swain wheel the portion of the bucket upon which the water would act by impact extends, as far as I can judge, a less distance towards the interior of the wheel than it does in Greenleaf, and the buckets being wider apart in Greenleaf than they are in Swain enables the water to act by impact more efficiently. The great reason why Mr. Waters appears to consider Swain different from Greenleaf, in respect to the first, second, third, and fifth claims (and I do not understand him to say that any of these differences are substantial and material), consists in the fact that the Greenleaf wheel works in a scroll, while the Swain wheel works in a case provided with what are called, in the reissued patent, "guides *e*," which Mr. Waters, as I understand, calls pitches, to direct the water on to the wheel. This reason has no effect upon my mind, because I believe the invention referred to in those claims to reside in the wheel alone, and by itself, and not in the
312 combination of a wheel of peculiar construction, with guides or pitches of peculiar construction; and for the further reason, that the wheel, considered by itself, will act in the same way in kind, whether surrounded by the well-known scroll case, such as is shown in the Greenleaf patent, or whether surrounded by the equally well-known and long used guides, such as are shown in the Swain patent, because the water in the scroll will act as if the scroll were divided up by partitions parallel to the surface of the scroll, the water entering farthest from the axis of the wheel following around the wall of the scroll, and acting upon the wheel at about the place where I have placed a cross-mark on the Greenleaf drawing Fig. No. 1; while that water which enters nearest the axis of the wheel will enter the wheel from the scroll at the point of entrance of water into the scroll; the scroll, in fact, forms a vortex chamber, and causes the water to enter the wheel or to strike against the wheel nearly in lines of tangents to the wheel.

Mr. Waters says that the Greenleaf wheel would not work well, because the passage of water through the sluices would not be by easy curves, as is the case in the Swain wheel. This statement as to the differences in the curves over which the water passes in the two wheels

is true, but I do not understand that I could evade the Swain patent by altering the form of his buckets so that the water would act more by impact at partly closed gate, thus forcing the water to pass through the sluices by more abrupt curves than it now does. Moreover the difference is one of degree and not of kind, and the difference therefore seems to me to be unimportant, especially when it is considered that the defendant's bucket, as I have before stated, is of different cross-section from the plaintiffs'.

Mr. Waters next states, near top of page 299, that the Greenleaf wheel is represented as having four buckets only, etc., and cannot well have more than these. More or less buckets are put into a wheel, according to the notion of a constructor, upon a perfectly well-known plan of making the curves approach more nearly to the radius as the number is increased; and the Greenleaf wheel, without any change of form of bucket, could have eight buckets put in it at least, and as many more as might be desirable, if the shape was changed in the usual way. As I understand it, the plaintiffs' wheel has twenty-four buckets, and
313 the defendant's only fourteen; and if the difference in the number of buckets has anything to do with the matter, then the defendant's is a different wheel from the plaintiffs'. But I do not understand Mr. Waters to consider the last distinction as to the number of buckets, and the other as to the difference of cross-section of buckets, to be substantial and material; and these differences of construction do, as he states them, no doubt exist.

(All parts of the preceding answer which are speculative are objected to by complainants' counsel.)

Int. 4. You have spoken of the chutes or guides, such as the Swain patent shows, and the scroll such as the Greenleaf patent shows, as being both well-known forms of chutes for guiding the water to a water wheel; about how long have they both been so known, so far as your recollection goes?

(Same objection as before.)

Ans. Twenty-five or thirty years.

Int. 5. Can the scroll of the Greenleaf patent be employed to direct the water in the Swain wheel instead of the chutes or guides shown in the Swain patent?

(Objected to as before.)

Ans. Yes.

Int. 6. And can the *the* chutes or guides of the Swain patent be also substituted for the scroll in the Greenleaf wheel?

(Objected to as before.)

Ans. Yes.

Int. 7. Does the specification of the Greenleaf patent, as illustrated by the drawings, show a water wheel and its appurtenances, which, in your judgment, would be practically successful? I refer to the modification of it as referred to by Mr. Waters and yourself, and as shown by the model marked "No. 1," and its scroll and case.

(Objected to as before.)

Ans. In my judgment it does. What percentage of useful effect it would give in proportion to the quantity of water expended could not be ascertained without experiment, but the wheel would certainly work, and I think give a fair percentage of useful effect.

Int. 8. In his answer to the eleventh interrogatory Mr. Waters points out certain differences between what is known as the Stowe
314 wheel and the wheel described in the Swain reissued patent. If you have examined the testimony in regard to the Stowe wheel will

you state how far you find the differences pointed out by Mr. Waters to exist, and how far you consider them material?

(Objected to as before, and because the witness has been already examined by defendant's counsel in relation to the Stowe wheel, so called, and touching the same in its relation to the Swain wheel.)

Ans. I do not understand Mr. Waters to state that the Stowe wheel considered as a wheel alone, differs at all or in any respect from the plaintiffs' wheel. His reason for stating that the invention of Stowe differs from that of Swain was because the water was not let in upon the Stowe wheel all around the wheel, so as to make it act as a turbine. Now if the water were spouted upon this wheel, as Mr. Waters supposes it to have been, it would not act as a turbine wheel but as a flutter wheel which was driven by the impact of water against the buckets; but if it were put either in a scroll case or inside of guides or pitches it would act as a turbine wheel, whether the water were delivered over the whole periphery of the wheel or only over a portion of the periphery. I may refer as an exemplification of this point to the wheel shown on page 4 of the pamphlet Exhibit O. In that wheel there are four gates, which move circumferentially over the pitches or guides. Now when these gates are partly shut they prevent water from entering between some of the guides, and the water therefore does not act upon the whole periphery of the wheel. But the wheel is not altered by this movement of the gate nor is its mode of operation altered, but in spite of this fact it ought to be a different wheel, if the admission of water to a part of its periphery only makes it a different wheel. I have before stated that I do not understand that the pitches or guides are referred to in the first, second, third, and fifth claims of the Swain reissue, and if the court should be of the same opinion, then the Stowe wheel exhibits the invention referred to in those claims.

Further, I think Mr. Waters has not carefully examined the Stowe testimony, because Mr. Stowe states, in addition to the statement made by Mr. Waters in regard to the size of the spout, that in the 1841 wheel the spout was four by eight, and that the end in the flume was fifteen inches by eight. As I understand, the 1841 wheel was only a twenty-
315 four-inch wheel, and a spout four by eight on such a wheel would cover a much greater part of the circumference of the wheel than a spout twelve by six on a seven-foot wheel, which is the spout Mr. Waters bases his opinion upon. A spout twelve by six on a two-foot wheel would be somewhat in the proportion of the sketch marked Exhibit Sketch of 1837 Wheel, and if the spout were in the proportions of that represented in the sketch then the wheel would act as a turbine wheel with water admitted to a portion of its periphery, and work exactly like defendant's wheel works when the gates are partly closed, under the supposition that the pamphlet before referred to represents the way defendant's gates worked. After full reading of Stowe I am of the opinion that the testimony as to the size of the spout is not perfectly clear, but I have given to it that effect as far as the twenty-four-inch wheel is concerned, which would give the idea that he so constructed the spout that it was only four inches across, measuring horizontally, which is the least favorable assumption for causing the wheel to act as a turbine.

(Answer objected to as conjectural and speculative.)

Adjourned.

BOSTON, *Feb.* 29, 1876.

Cross-examination by J. S. ABBOTT, esq., of counsel for complainants.

(Complainants' counsel, not waiving any of the objections hereinbefore noted, but insisting upon them, and claiming that all of the testimony taken on the 28th of February shall be disregarded and stricken out, propounds provisionally, de bene, the following questions:)

Cross-int. 9. Did you ever make or assist in making a turbine water wheel for practical use? If so, when and for whom?

Ans. I never have.

Cross-int. 10. Did you ever design, or assist in designing, a turbine water weeel for practical use? If yea, when and for whom?

Ans. I never have.

Cross-int. 11. Did you ever test any turbine water wheel for the purpose of ascertaining its percentage of efficiency? If yea, when, where, for whom, in what manner, and with what results?

316 Ans. I never have.

Cross-int. 12. Did you ever operate any turbine water wheel in any mill, or in connection with any mill? If yea, when, where, for whom, and how long?

Ans. I never did. I have seen such wheels in operation.

(Last sentence objected to as irresponsive, and the witness is reminded that in the cross-examination there should be no departure in the answer from the question.)

Cross-int. 13. Did you ever see in operation, or fitted and placed for operation, a water wheel made under and in exact accordance with the description and drawings of the said Greenleaf patent?

Ans. I never have.

Cross-int. 14. Did you ever see and examine, while in operation, any water wheel like the complainants' patented wheel? If yea, when, where, and by or for whom operated?

Ans. I may have seen one in operation, because I have seen turbines in operation when I didn't know exactly how they were built, or whose make they were; but I am certain I have never examined one closely while in operation.

Cross-int. 15. Did you ever see and examine, while in operation, any water wheel like complainants' Exhibit D, being defendant's water wheel, or any water wheel manufactured by or for the National Water Wheel Co.?

Ans. I make the same answer as to the last question.

Cross-int. 16. Did you ever see and examine, while in operation, any water wheel like complainants' Exhibit T, or like the wheel referred to in your testimony on pages 184–187 of the printed record, and called the Whitney wheel?

Ans. I make the same answer as to the fourteenth cross question.

Cross-int. 17. Did you ever see in operation any wheel such as is described in the patent granted to Temple, Mills & Stout? I refer to defendant's Exhibit 12. If yea, when and where?

Ans. I cannot tell whether I have or not.

Cross-int. 18. Have you any recollection of having seen any such wheel?

Ans. I have not. I may have seen it, without knowing what wheel it was.

317 Cross-int. 19. What works or books have you read or studied relating to turbine water wheels?

Ans. Several; but I cannot now tell you the names of any one of them.

HENRY B. RENWICK.

Attest:

JOHN G. STETSON,
Examiner.

Exhibit 10, *N. A. P., special examiner.*

Letters patent of the United States, No. 10916, granted Abel Greenleaf May 16, 1854. Improvements in gravity and percussion water-power machines.

SPECIFICATION.

To all whom it may concern:

Be it known that I, Abel Greenleaf, of Kingston Township, in the county of Luzern, and State of Pennsylvania, have invented certain new and useful improvements in "gravity and percussion water-power machines," and I do hereby declare that the following is a full, clear and exact description of the same, reference being had to the accompanying drawings making part of this specification, and to the letters of reference marked thereon, in which

Fig. 1 is a longitudinal section of the machine in which is shown a sketch of the center part of the hub, or main body of the wheel, and the inner or central part of the main buckets.

Fig. 2 is a cross-section of Fig. 1 in the line *x x*, and viewed in the direction of the dart (the wheel not being shown).

Fig. 3 is a side view of the wheel and shaft removed from its place in the machine.

Fig. 4 is a section of Fig. 3 in the line *x x*, and viewed in the direction of the dart.

Fig. 5 is an end view of Fig. 3.

318 Fig. 6 is a portion of the hub or main body of the wheel, with the buckets and rims removed.

Figs. 7, 8, 9, 10, 11, 12, 13, 14, and 15 are all auxiliary drawings, showing some of the principles of this machine developed in different forms.

Fig. 7 being a sectional side view of a portion of the machine showing one of the forms of arrangir g the gate and throat to the same.

Fig. 8 is a side view of the wheel in one of its forms.

Fig. 9 is an end view of the same with part of the rim removed.

Fig. 10 is an end view of the wheel in another of its forms.

Fig. 11 is a sectional side view of Fig. 10 developed, having a portion of the rims R R removed.

Fig. 12 is an end view of the center hub of the same, with the spiral floats or buckets H H attached.

Fig. 13 is a side view of the center hub of the same.

Fig. 15 is a side view of the wheel in another different form.

Fig. 14 is an end view of the same with a portion of the rim R R removed.

In describing my improvements in detail, the same letters refer to the same parts of the machine in all the figures, excepting the letters *o*, which refer to different parts in the different figures.

A A represents the main body or sides of the machine forming a part of the water guide; around the wheel B B B is the main part of the scroll or water guide; around the wheel C C is a crooked lever or yoke

which connects the rings F F together and hold them in contact with the ends of the wheel. D D are the pillar blocks on which the wheel and shaft rest and turn. E E E E are the main buckets of the wheel. F F are rings for the ends of the wheels to run against. G G G G is the main body or hub of the wheel. H H are spiral floats attached to the center part of the hub, between the main buckets. L L is the shaft of the wheel. K K is the gate, combined with a portion of the scroll which surrounds the wheel. X represents one of the water guides to direct the water into the throat, one not being shown.

In order to enable others to make and use my invention, I now proceed to describe its construction and operation.

319 I make the sides A A of the machine of plank of suitable thickness, dressed true upon their inner sides and edges, and fasten them together by putting screw bolts through them near their ends from top to bottom. The holes in which the rings F F are placed, I make a little larger than the rings, so as to receive strips of leather around the rings as shown at *f f f f*, Fig. 2, the outer edges of which are nailed fast in the openings around the rings. The inner edges act as valves to prevent the escape of water between the rings and the sides A A, and at the same time the rings are left free to move as required in adjusting them to the ends of the wheel. The rings F F I usually make of cast iron in the form shown in the drawings, the use of which is to prevent a waste of the water between the ends of the wheel and the sides A A of the case.

The crooked lever *c c* I make of wood or iron in the form shown, having the set screws I I passing through the ends of it into the opposite countersinks in the ears *g g* of the rings, by which means the rings are brought to, and kept adjusted with and to the ends of the wheel. Any suitable number of these crooked levers I use for this purpose, although I have shown but one in the drawings.

I have another method of connecting the rings F F together, and adjusting them to the ends of the wheel (not shown in the drawings), namely, by extending the ears *g g* of the rings long enough outwards to allow long screw bolts to pass outside of the staves B B B from one to the other, and through the ears of both. The gate K K, Fig. 1, I commonly make of wood in the form shown, the front side of the upper portion of it forming a part of the throat, and the lower portion forming a part of the scroll. It is hung upon a long bolt passing through it at *v*, and through the sides A A, between which it works. The upper portion of the gate is nicely fitted to the sides A A to prevent leakage of water between them.

To prevent the escapement of water under the upper part of the gate I nail a strip of leather through its edges to the stave immediately under the gate, as shown at *r r*. A recess shown at *s* is cut (and over which the leather is placed) with the openings shown at *l*, leading into it, to allow water to pass from the penstock up under the leather, and press it against the gate with sufficient force to prevent any water from passing between them.

320 The lower portion of the gate I make a little narrower than the space in which it works, to allow water to pass into the chamber behind it, shown at *q*, in order to neutralize the pressure of the water upon the front side of it, and thereby allowing it to work easily in opening and shutting, which is effected by a lever connected with the eye-bolt, as shown at *p*, and with the lever or arm of an ordinary roller or otherwise. That part of the machine represented at B B B, and extend-

ing from Y around to S, I make of staves of any suitable size for the purpose intended. Tenons (not shown) are made on both ends, corresponding in shape with the inner sides of them, which are made in such shape as to form the parts here represented, when put in their places. The tenons upon the staves are inserted into corresponding grooves or mortises cut in the side pieces A A for the purpose. I put long screw bolts (not shown) through holes in A A, Fig. 1, as represented by *o o o o o o o*, passing entirely through both of the sides A A, by which means the staves are held firmly in their places between them. The pillar blocks, D D, I make of wood in the form shown. The wheel of this machine, as represented in Figs. 3, 4, 5, and 6, and which contains all the principles which are developed in the several different forms represented in the other accompanying drawings, I construct in the following manner: The shaft, L L, I make of wood or iron in the form shown or otherwise, of sufficient strength and size for the purpose intended, and provide it with gudgeons upon which it turns. The hub, G G G G, I usually make of a solid piece of wood through which the shaft passes, and to which it is secured. The centre part of the hub is in its section of a conical form, as represented at Z Z.

The floats or flanges H H I make broad at their outer ends and taper them nearly to a point at their inner ends, as represented in the drawings. They are fastened to the hub by screws or pins. They are made winding, like the thread of a screw, to suit the angular position in which they are placed upon the hub. The portions of the hub on which the buckets E E E E are attached are made in spiral or wedge like form, as shown at N N N N, by cutting away portions of the hub, as shown at *o o o o*, Figs. 4, 5, and 6.

The buckets E E E E I make in the form shown, they being cast sep-
321 arate, each with a section of the rims R, R, attached to it, the ends of which came together as shown at P, P, P, P. I make the outer surface of the inner edge of the buckets the arc of a circle or nearly so (as shown at section in Fig. 4) from the ends at U, U, U, U, to V, V, V, V, where the circular form suddenly stops or unites with the straight line which is represented at VI, VI, VI, and VI. This change of curvature and angles of the buckets I extend outwards the entire breadth of them, varying in form as it passes through their concave parts until it reaches the outer edge of the buckets, where the plane or straight parts run parallel to and unite with the rims R, R, as shown at W, W, Fig. 3. The flanges 22, Figs. 3 and 4, are cast solid with the main buckets and form a part of them. The buckets E are fastened to the hub, which is made to fit their inner sides by screws, pins or otherwise. Two pairs of the spiral floats H, H are generally used placed opposite each other upon the hub, and a corresponding number of flanges upon the main buckets to unite with them as represented, although but one pair of each is shown in the drawings. The bands S, S, are made of wrought iron put on hot to hold the ends of the wheel firmly together, and to form a surface to run against the rings F, F, their outer sides being set true for the purpose.

In constructing the wheels I sometimes form the portion VI of a form slightly curved. The wheels represented in Figs. 8, 9, 10, 11, 12, 13, 14 and 15 are various modifications of Figs. 3, 4, 5 and 6, but based upon the same general principles. Fig. 7 is a modification of the combined gate, as shown in Fig. 1.

In attaching this machine to a penstock or flume, I so place it as to cause the breast of the throat to come even with the bulkhead planking as shown at Y, Fig. 1. The water guides, X, I make of plank in the form shown, and fasten them to the planks, Y, and also to the sides A

A of the machine by nailing or otherwise. I use two of these guides, one on each side of the throat, although there is but one shown in the drawings. They serve to cause the water to enter the throat in a smooth solid stream from the penstock above it.

In constructing the wheels of this machine in the forms represented in Figs. 3, 8, and 15, it is my intention in some cases to dispense with the broad hub, and substitute in its place thin flanges connected
322 with the inner sides of the buckets E, E, E, in their centers, which are in this case connected together in the center of the wheel. These flanges have others connected with the inner edge of them in such form and manner as to form a suitable hub to support the wheel upon the shaft, and in which case I intend sometimes to attach spiral wedge-like pieces to the sides of the flanges and the insides of the buckets, which are intended to act as substitutes for the spiral or angular surfaces shown at *o*, *o*, *o*, *o*, Figs. 4, 5 and 6, in facilitating the passing out of the water from the wheel as hereinafter more fully explained.

When this machine is in operation the water passes from the penstock through the throat into the scroll, in the direction given to it by the throat in front of the gate, until it reaches the wheel and presses against the angular surface of the buckets exposed to its direct action, and causes the wheel to run in the same direction as the water, with a velocity and power in proportion to the head of water acting above. The water, having done its execution upon the wheel, passes through the openings between the buckets towards the shaft and passes out at the ends of the wheel. In order to prevent, as far as possible, the objection arising from the reaction of the water escaping through the wheel upon the inner surfaces of the buckets by its centrifugal force, the ends of the wheel are enlarged, as shown in Figs. 3, 5, 14, and 15, by which means the water has a far more free and direct discharge than it would have if the enlargement was not made and the face sides of the buckets made to run parallel with the shaft their entire breadth.

The spiral or wedge form given to the portions of the hub represented at *o*, *o*, *o*, *o*, in Figs. 4, 5, 6, 9 and 14, is intended and does serve to prevent, in a considerable degree, the reaction of the water upon the inner surfaces of the buckets, by covering a portion of the same and thereby preventing the water from coming in contact with it, and also by crowding against and urging the water out of the wheel. These preventives of reaction are very beneficial in starting the wheel from a state of rest when heavily loaded; in which case the tendency of the escaping water to react upon this kind of wheels is far greater than when they are in motion, as it takes a rapid circular backward motion through the
323 wheel when in a state of rest. This tendency to reaction is greatest in cases where the head of water used is moderate, and the volume of water applied to the wheel large, and the wheel broad, in proportion to its diameter. The peculiar shape given to the portions of the main buckets as represented at VI, VI, VI, VI, Figs. 4, 9, and 14, and also shown at W, W, Figs. 3 and 11, is designed to and does cause an increase of pressure of water at and near those points and by means of which the maximum velocity and power of the wheel is considerably increased, and which tends also to arrest more perfectly the forward motion of the water whilst acting directly upon the wheel, which otherwise would, by its centrifugal force, cause considerable reaction upon it, to diminish its velocity while passing through and out of it. The combined gate represented at K, K, and hereinabove explained, serves to cause the water to flow in a solid, smoooth stream to the wheel, when the gate is but partially drawn, as well as when it is entirely opened, and

thereby preventing the formation of an eddy below the gate, as is usually the case where gates of the ordinary construction are used and only opened a part of the way; and which is of frequent occurrence in using these and similar machines. The dotted line at *n* shows the position of the front side of the gate when shut; the one at *m* shows it when it is half-way drawn. The operation of the spiral floats or flanges H, H, combined with the conical form of the hub, is to receive the first action of the water striking against the center of the wheel at its periphery, before coming in contact with the buckets E, E, whereby the force of the water is used to more advantage than when the spiral floats are used with a cylindrical hub, as by this form and combination no dead water is carried round by that portion of the wheel. The rings F, F, by being connected or yoked together by crooked levers and set screws, as represented at *c*, *c*, Figs. 1 and 2 (and above described), independent of any fastening to the sides A, A, of the case, are allowed to move freely with the wheel to suit themselves to any new position it may assume, and thereby heavy friction and consequent loss of water between the rings and the ends of the wheel is, in a great measure, prevented. The connecting or yoking the rings together by means of long screw bolts passing through the ears of both of them, as hereinabove set forth, is
324 intended also to make the rings self-adjusting to the position of the ends of the wheel after being brought to their places and properly adjusted, and which, in some cases, produces about as favorable results in preventing friction and loss of water between the wheel and rings as by using the crooked bars for the same purpose.

Having thus fully described the above machine for the purpose of illustration, I would have it expressly understood that I do not claim it in whole or in part as my original invention, excepting and reserving what is contained in the following claims, to which I limit myself. But what I claim as my invention, and desire to secure by letters patent, is,

1st. The combination of the gate with the scroll, substantially in the manner described, and for the purposes specified.

2d. The recess (*s*) and the apertures (*l*) leading thereto, in combination with the leather at *r*, *r*, or its equivalent, substantially as described, and for the purpose specified.

3d. The spiral or wedge-like form given to the portions of the wheel as represented at *o*, in combination with the buckets thereof, substantially as described, and for the purposes specified.

4th. The tapering form given to the floats H, in combination with the double cone-like shape given to the portion of the hub to which they are attached, substantially as described, and for the purposes specified.

5th. The change of curvature in the buckets at or near their ends, as shown at VI, arranged so that these ends shall not be overlapped by the ends of adjoining buckets, substantially as described, and for the purposes specified.

ABEL GREENLEAF.

Witness:
REUBEN JONES.
A. C. CHURCH.

325. *Exhibit* 11, *N. A. P., special examiner.*

Letters patent of the United States No. 42708, granted Waldo Whitney, May 10, 1864. Improvement in water wheels.

SPECIFICATION.

To all whom it may concern:

Be it known that I, Waldo Whitney, of Manchester, in the county of Hillsborough, and State of New Hampshire, have invented certain new and useful improvements in water wheels; and I do hereby declare that the same are described and represented in the following specification and drawings:

The nature of my invention and improvements in water wheels consists in a peculiar shaped bucket or float in combination with an inverted conical centre.

And in a concave disk or basin around the wheel, provided with guides or chutes, direct the water tangentially against the wheel.

Also, in a cylindrical gate arranged between the curb and the wheel, and fitted to traverse circularly around the wheel, and open and close the chutes or apertures that supply the wheel with water.

To enable others skilled in the art to make and use my improvements, I will proceed to describe their construction and operation, referring to the accompanying drawings in which the same letters indicate like parts in each of the figures.

Fig. 1 is a plan or top view, one-half of the case and one-fourth of the cover being omitted to show the interior.

Fig. 2 is a section of Fig. 1, cut perpendicularly through the centre.

Fig. 3 is a portion of the curb which surrounds the wheel, with a portion of the gate which is between the curb and the wheel.

In these drawings A is the base or bottom frame, provided with an adjustable pivot B for the shaft C of the wheel D to turn as
326 shown in Fig. 2. The top and centre of the wheel D consist of the inverted cone E fastened to the shaft C by the disk at the bottom of the cone.

The buckets or floats F are made in the form shown in the drawing and fastened to or cast with the inverted cone E, and their outer lower corners are fastened to or are surrounded by the rim, or hoop G. The outer edges of the floats F are perpendicular and nearly radial. They then curve so as to join the lower end of the cone E, nearly in a tangent, while that part of the float below the cone extends downwards and backwards beyond the perpendicular part of the next float, and is inclined and curved outward and joined to the hoop G.

H is a concave disk or basin surrounding the wheel and supported by the standards I, I, from the frame A. This disk, H, has an opening in the centre just large enough for the hoop G of the wheel to turn freely in, and the top of the hoop should be just even with the inside of the bottom of the basin. The cylindrical curb J surrounds the wheel, and is fastened to or cast with the basin H and is provided with a cover, K, to keep the water from the top of the wheel, or inverted cone, E. This curb, J, is provided with long, perpendicular openings, J′, through which the water passes on to the wheel, and there are guides, L, L, either curved or straight, fastened to the sides of the openings and to the basin forming chutes, M, which direct the water tangentially on to the wheel or against the floats, so as greatly to increase the power of the wheel in proportion to the quantity of water expended.

The curb J is made enough larger than the wheel to permit the cylinder gate N to rotate between the curb and the wheel. This gate, N, is fitted to the inside of the curb and rests on the basin H and is provided with openings, N′, corresponding with the openings in the curb for the water to pass through on to the wheel. The gate N is provided with a rack of teeth, P, which project through an opening in the side of the curb and may be acted on by a pinion, to rotate the gate and open and close the openings in the curb through which the water passes on to the wheel.

The form of the frame A is shown by dotted lines in Fig. 1, and also the form of the float F, as seen perpendicularly.

327 Q is a top case covering the wheel and basin, H, to receive and hold the water over the basin and wheel. The water enters the case Q through an opening, the sides of which opening are shown at R, R in the drawings.

With my improvements, a part or fraction of the water may be applied to the wheel with nearer a proportionate result to the whole than upon any other turbine or reaction wheel known to me.

I believe I have described and represented my improvements in water wheels so as to enable any person skilled in the art to make and use them without further invention or experiment. I will now state what I desire to secure by letters patent, viz:

In combination with the peculiarly shaped floats F, I claim the inverted conical centre E and hoop G, to which the floats are fastened.

In combination with the concave disk or basin around the wheel, I claim the stationary guides L and chutes M, to direct the water on to the wheel, substantially as described.

I claim the cylindrical gate N, arranged between the curb and the wheel, and fitted to traverse circularly around the wheel, and open and close the chutes or apertures which supply water to the wheel.

WALDO WHITNEY.

Witness:
ISAAC RIDDLE.

Exhibit 12, *N. A. P., special examiner.*

Letters patent of the United States, No. 22902, granted John Temple, assignor to Temple, Mills & Stout, Feb. 8, 1859. Improvement in water wheels.

SPECIFICATION.

The schedule referred to in these letters patent and making part of the same.

To all whom it may concern:

Be it known that I, John Temple, of Middletown, in the county of Butler and State of Ohio, have invented a new and useful im-

328 provement in water wheels, and I hereby declare the following to be a full and exact description of the same, reference being had to the accompanying drawing (making part of this specification) in which—

Fig. 1 is a top view of the scroll chest.

Fig. 2 is a view partly in axial section and partly in elevation.

Fig. 3 is a horizontal section at *x*, *x*, Fig. 2.

This is an improvement in what are known as central discharge or

vertical reaction wheels, and the invention consists in a certain form and disposition of buckets, whereby the forces of percussion, reaction and gravity are made fully available.

The crown D of the wheel, for a distance inward of about one-half the radial depth of the buckets, is a horizontal plane, and thence to the back of the buckets is an inverted conic frustrum of about 45° (or the crown may curve inward and downward from the margin of the wheel to the back of the bucket). The buckets, in all their horizontal sections, present a cyma reversa curve, substantially such as shown in Fig. 3. The front part (1), which receives the percussive force of the head, being concave, and the rear part (2), which receives the reacting force, convex. The vertical sections present everywhere a cycloidal or circular arc tending outward as it descends (see Fig. 2), so as to present at the lower part of the discharge orifice an "apron" (3), adapted to receive and apply the gravitating force of the water. The receiving of the buckets (at 2), by enlarging the outlets, prevents the gorging of the passages under the diminished flow towards the discharge, incident to a central discharge wheel, and prevents any pressure of water against the backs of the buckets.

I am aware that central discharge water wheels having buckets recurved horizontally, or in the plane of rotation, have been long in use. I therefore do not claim such a mode of constructing wheels, but my invention involves important improvements on the cyma reversa bucket, whereby I obtain in this class of wheels the advantages of percussion and reaction, and in addition thereto a sufficient retention of the water to avoid the force of gravity.

I claim as new, and of my invention herein—

329 The construction and arrangement in central discharge water wheels of buckets E, which have the described compound cyma reversa and downward and outward curve, whereby the water acts on the wheel by percussion, reaction, and gravitation, and escapes freely without back action, as set forth.

In testimony of which invention I hereunto set my hand.

JOHN TEMPLE.

Witnesses:

GEO. H. KNIGHT.

I. B. LEFFERSON.

330 The following is the opinion of the court in accordance with which the decree of this circuit court dismissing the bill of complaint in this cause was entered January 2, 1877, namely:

Opinion of the court.

SHEPLEY, J.:

The invention of Swain, the assignor to the complainants, relates to a new and improved form of that class of water-wheels known as turbines, which operate by means of extracting power from the unbalanced pressure of water, which, as it passes through the wheel, has its direction changed by the curved surfaces of the floats which take and transmit the power of the water impinging upon and passing over their curved surfaces. In all wheels of this class, form is material, substantial and functional, and very slight changes of form and proportion involve functional changes of great importance. Slight modifications and deviations from any prescribed operative forms and proportions may destroy the usefulness or put an end to the identity of the device, or on the other hand may effect new and different and better results.

331 Before the invention of Swain, the turbine wheels in common use were generally classed under two heads, the Fourneyron and the Jonval wheels. The wheels of the Fourneyron type received and discharged the water horizontally. The wheels of the Jonval type received the water vertically from the top and discharged it downwardly. Various modifications had been made and many patented of both of these forms of the turbine wheel. That Swain made a great improvement upon any of the turbine water-wheels which preceded his is very evident, and no testimony in the record, in the opinion of the court, has any tendency to show that he was not the first and original inventor of that which he claimed in his original patent. Valuable and meritorious as that invention was, it entitles him only to a monopoly of that which he really invented, and no inventor has any right to gradually widen the scope of his claims to keep pace with the progress of invention. Especially, in cases where mere changes of form become patentable by reason of involving functional differences, should it be left open to subsequent inventors to devise other changes of form involving other functional changes, where the same result is not attained in substantially the same way.

In order properly to construe and limit the claims of the reissued patent in this case, so as to give to the patentee the entire monopoly of the invention actually made by him, and at the same time to so limit it as not to cover a field of invention into which the patentee had not entered, it becomes necessary to examine the original patent and endeavor to determine from that what was the scope of the invention which was described, indicated or suggested in the specifications of the original patent. The original patent granted to A. M. Swain, May 15, 1860, for a new and improved wheel, No. 28314, describes the object of the invention "to obtain a simple and efficient horizontal water-wheel, one
332 that will have all its parts accessible for repairs, and which will give the maximum power of varying heads, with an economical use of the water." After describing the devices for raising and lowering the wheel as desired, without removing the wheel from its proper working position, and without being troubled with the influence or action of the water, the description of the wheel and its floats is as follows:

"The wheel has its floats cast or constructed each of a single piece of metal. The face sides of the floats, where the water impinges, are of paraboloidal form, whose axes are tangent to a circle, to which the guides, hereafter described, are also tangents, and also to the curve at or near the circumference of the wheel. The bottoms of the floats are formed by revolving the curves on their axes."

A description is then given of the annular chamber, termed the hydrostatic chamber, around the wheel, with a series of guides which, in connection with the top of the chamber and the cylinder connecting the guides at the bottom, form chutes which direct the water properly to the buckets of the wheel, and an arrangement is provided by means of raising and lowering them to increase or diminish at will the volume of water admitted to the wheel, thereby regulating the capacity of the wheel as occasion may require.

"When J (the ring or cylinder to which the guides are attached and cast) is lowered, the water strikes the floats with all the force and velocity due to its head, directly under the rim of the wheel, which is so curved as to force the water down rapidly in the lower curved parts or bottoms of the floats, the water not leaving the wheel until its force has been properly expended on it."

When we examine this specification in connection with the drawings to which it refers (leaving out of view, for the purpose of this examination, the annular chamber with the guides and chutes, and the devices for raising and lowering the wheel), we find the essential elements of the wheel to be first, floats whose face-sides where the water impinges are of paraboloidal form, whose axes are tangent to a circle to which the guides are also tangents, and also to the curve at the outer circumference of the wheel. We find the upper edge of the floats
333 not to be horizontal to the axes of the wheel, but curving downwards, inwardly, diagonally, so as to conform to the rim of the wheel to which the floats are attached, which is so curved inwardly and downward. We find these floats with a discharge line curving over their inner edges from the curved crown to the lower outer edge of the wheel, the float thus narrowing almost to a point at the lower band or rim of the wheel. This form of float, acting in combination with the curved part of the crown, and the hub inside of the inner edges of the floats, discharges the water neither horizontally or vertically, with reference to the axis of the wheel, but in diagonally curved lines. Secondly, we find, as one of the elements of this wheel, a rim or crown, "which is so curved as to force the water down rapidly in the lower curved parts or bottoms of the floats." This downward and inward curvature of the crown is not described as an alternative or preferable construction, but as one having an important function in combination with the floats. As correctly stated by Mr. Renwick, one of the experts examined by the defendant, if there had been any intention of discharging the water in merely horizontal lines, the lower side of the rim or crown would not have been bent downwards, so as to force the water down, and the space in the centre of the wheel, into which the horizontally flowing water would escape, and which would be necessary for its escape, would not have been stopped up by the hub and the downward prolongation of the crown, after it extends inwards beyond the inner edges of the buckets. And if it had been intended that any considerable portion of the discharge should have been downwards (vertical), as in the Jonval wheel, then the delivery edges of the buckets would not have been curved as before described. This view of the office and function of the downward curved crown is further confirmed by the arrangement of the chutes in the Swain device in such a man-
334 ner as that the water at part-gate is admitted directly under the curved rim of the wheel.

The reissued patent No. 28314, dated November 19, 1872, has its first, second, third, and fifth claims so worded as in their broad and literal construction, without any limitation to the invention described in the specifications of the original and the reissued patent, to claim any form of "water-wheel having an effective inward flow and discharge of part of the water, and an effective downward flow and discharge of part of the water simultaneously in one wheel, whereby the effective area of discharge is increased without increasing the diameter of the wheel." This is the exact language of the fifth claim, which would be void as a claim merely functional, unless this claim be construed, as must also the first, second, and third claims, as including the described means of effecting the result. To uphold these claims they must not only be construed in connection with the described means in the reissue, but so construed as not to embrace any invention broader in its scope than the invention described or substantially suggested or indicated in the original. However meritorious and original the invention of Swain was (and of its originality and merit as an advance in the state of the art at the

date of Swain's invention the court does not entertain any doubt), nevertheless, its great merit and utility will not justify such broad claims in a reissue as shall effectually interpose a barrier in the path of subsequent inventors and arrest the progress of invention. The broad language of these claims, liberally construed, eliminates from the combination in the reissue the downward and inward curvature of the crown which forms an essential functional element of the combination in the original. Such a literal construction of these claims, with the scope contended for by the complainants, would render the reissue void,
according to the decisions in Wells v. Gill, and many other cases
335 decided by the Supreme Court of the United States, including
Seymour v. Osborne. In this connection the court can only repeat the language of the opinion in Forsyth v. Clapp, 1 Holmes:

"The court will look beyond the mere form of words in the claim of a reissued patent into the specifications in both the original and reissued patents; and, even if on the face of the reissued patent it does not embrace anything not described or suggested in the original, nevertheless, the court will ascertain whether there is any substantive invention adequate to support a claim ingeniously worded, not so much for the purpose of describing what the patentee really invented as of grasping within its terms some contrivance, not within the knowledge or contemplation of the patentee, and for that reason, not by inadvertence or mistake, not embraced in the claims of the original patent."

Giving to these claims the construction which we have indicated, the word crown in the first three claims will refer to and include in the combination such a crown as is described in the original patent and represented in the drawings of the original and the reissue, and the fifth claim will be limited in its scope to water wheels possessing such elements as we have hereinbefore recited as the described essential component parts of the turbine wheel described in the specifications and drawings of the original patent. Giving this construction to the claims, the defendant does not infringe, and the bill must be dismissed.

336 UNITED STATES OF AMERICA,
Massachusetts District, ss:

I, John G. Stetson, clerk of the circuit court of the United States for the first circuit and district of Massachusetts, hereby certify that the foregoing is a true copy of the record, and of all proceedings (including the opinion of the court) in the cause in equity entitled Swain Turbine and Manufacturing Company, complainant, v. James E. Ladd, defendant, lately determined in said court.

337 In testimony whereof I have hereunto set my hand and affixed the seal of said circuit court, at Boston, in said district, this seventh day of April, in the year of our Lord one thousand eight hundred and seventy-seven, and of the Independence of the United States the one hundred and first.

[SEAL.] JOHN G. STETSON, *Clerk.*

338 Know all men by these presents that we, The Swain Turbine and Manufacturing Company, a corporation organized and existing under the laws of the Commonwealth of Massachusetts, and having its usual place of business in Lowell, in said Commonwealth, as principal, and George W. Harris and Danville Cole, both of said Lowell, as sureties, are held and firmly bound unto James E. Ladd, commorant at Mill River and other places within said Commonwealth, in the full and just sum of twenty-five hundred dollars, to be paid to the said James

E. Ladd, his certain attorney, executors, administrators, or assigns; to which payment, well and truly to be made, we bind ourselves, our heirs, executors, and administrators, jointly and severally, by these presents, sealed with our seals and dated the 29th day of January, in the year of our Lord one thousand eight hundred and seventy-seven.

Whereas lately, at a circuit court of the United States within and for the district of Massachusetts, in a suit in equity depending in said court between said Swain Turbine and Manufacturing Company, complainant, and said James E. Ladd, defendant, decree was rendered against the said Swain Turbine and Manufacturing Company, and the said company having obtained an appeal to remove the said cause to the Supreme Court of the United States to reverse the decree in the aforesaid suit, and a citation directed to the said Ladd citing and admonishing him to be and appear at a Supreme Court of the United States to be holden at Washington on the second Monday of October next:

Now, the condition of the above obligation is such that if the said complainant shall prosecute its said appeal to effect, and answer all damages and costs if it fail to make its plea good, then the above obligation to be null and void; otherwise to remain in full force and virtue.

SWAIN TURBINE M'F'G CO.,
By A. F. NICHOLS, *Treas.* [L. S.]
DANVILLE COLE. [L. S.]
G. W. HARRIS. [L. S.]

Signed, sealed, and delivered in presence of—
H. W. BOARDMAN to A. F. N., treas., & G. W. H., also to D. Cole.

Approved under the order of the court.
JOHN G. STETSON, *Clerk.*

A true copy of the bond taken by the judge at the time of allowing the appeal named in said bond, which bond is on file in the office of the clerk of the circuit court of the United States for the first circuit and district of Massachusetts.

Attest:

JOHN G. STETSON,
Clerk U. S. C. C., Mass. Dist.

(Indorsement on cover:) No. 299. Swain Turbine and Manufacturing Company, appellant, vs. James E. Ladd. Massachusetts C. C. U. S. Filed 15th October, 1877.

JAMES H. McKENNEY, Clerk

Supreme Court of the United States.

IN EQUITY.

No. ~~300~~. 41.

Swain Turbine and Manufacturing Co.,

APPELLANT,

v.

JAMES E. LADD,

APPELLEE.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES, FOR THE DISTRICT OF MASSACHUSETTS.

BRIEF FOR APPELLANT.

JOHN S. ABBOTT, *Counsel for Appellant.*

BOSTON:
TOLMAN & WHITE, LAW PRINTERS,
383 WASHINGTON STREET.
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1880.

Supreme Court of the United States.

No. 299.

SWAIN TURBINE AND MANUFACTURING COMPANY, APPELLANT,

v.

JAMES E. LADD, APPELLEE.

Appeal from the Circuit Court of the United States, for the District of Massachusetts.

BRIEF FOR APPELLANT.

The bill in this case is filed against the defendant for the infringement of the reissued Letters Patent granted to the Swain Turbine Company, assignee of Asa M. Swain, the alleged inventor, Nov. 19, 1872. The original patent was granted May 15, 1860.

TITLE OF COMPLAINANT.

The title of the complainant is particularly stated in the bill (pp. 1 and 2, paragraphs 1 to 11); and it is established by the original Letters Patent, the reissue, the certificate of extension, and by duly authenticated copies from the Patent Office of the records of the several assignments named in the statement of title. (pp. 17–27.)

These assignments were put in evidence subject to four objections on the part of the defendant. (p. 18.)

"First. *For want of proof of the execution of each of said instruments by the parties thereto.*"

Answer. "Written or printed copies of any records . . . belonging to the Patent Office, authenticated by the seal and certified by the commissioner, or acting commissioner, shall be evidence in all cases where the originals could be evidence."

Rev. Sts. of U. S., Title XIII., ch. 17, § 892.
Parker v. *Haworth*, 4 McLean, 371.
Brooks v. *Bicknell*, 3 McLean, 434.
Lee v. *Blandy*, 2 Fish. 89.

"Second. *For want of proof of the power of H. W. Boardman, attorney and agent, to execute, on behalf of the Swain Turbine Company, the assignments of Dec.* 22, 1873, *and June* 2, 1874."

There are several answers to this objection.

(*a*) The answer already given to the first objection applies also to this. There is no exception, in the above statute, of assignments to the party offering the copies. The copy, therefore, is *prima facie* evidence; and, there being no opposing proofs, is conclusive.

(*b*) As to the assignment of December 22, 1873, it will be noticed that it is an assignment from said Swain, and not from the Swain Turbine Company; and it is unnecessary to prove its execution by the company, except in case of suit by Swain against the company for alleged non-performance by the company of its agreement.

(*c*) Albert F. Nichols has been the clerk and treasurer of the Swain Turbine Company since 1869; and he was clerk and treasurer of the Swain Turbine and Manufacturing Company during more than a year prior to the giving of his deposition. (pp. 27, 28.) He was present at meetings of the stockholders and of the directors of these corporations held in June, 1874, when Mr. Boardman was author-

ized to execute the agreement in the assignment of December 22, 1873, and the assignment of June 2, 1874. There was no record made of the giving of this authority, or of any vote relating to it. Hence the objections noted, because of the non-production of the records on pages 35 and 36, are of no importance. The production of the records and the exclusion of oral testimony can be properly required only when the oral testimony is offered to prove authority given, or proceedings had, *which are recorded.*

The authority of H. W. Boardman to execute the assignment of the Swain Turbine Company to the complainant, on pages 26 and 27, is proved by Albert F. Nichols. (pp. 27–28, 35–37.)

"A contract in writing may be binding on a corporation, though a private seal of one of its officers was used instead of the corporate seal; *and though no record may be found authorizing the officer to make the contract, if other evidence proves that he had such authority, or that the company ratified his act afterwards.*"

Eureka Company v. *Bailey Company*, 11 Wall. 488.

(*d*) The authority exercised by said Boardman is proved to have been fully ratified by the Swain Turbine Company, and also by the Swain Turbine and Manufacturing Company; the validity of said assignments is thus established, even were it to be conceded that he had no authority at the times when they were executed. (See pp. 28, 29, 36–37; Ints. 12–23, and Cross-Ints. 88–92.)

"Third. *For want of proof of the corporate organization of the Swain Turbine Company, and the Swain Turbine and Manufacturing Company.*"

(*a*) As to the Swain Turbine Company, the introduction of certified copies of the records of the assignments to and from that com-

pany made by the statute referred to competent evidence, is a sufficient answer to this objection. But whether this company was properly organized or not is quite immaterial. It is proved by said Nichols that persons acting under that name transacted business; and it appears that under that name the patent was assigned *to* and also *by* them; and whether they were a corporation, or a *quasi* corporation, or a partnership, would be immaterial as affecting the validity of the transmission of this title. In addition to this, the objection is not open to the defendant, he not having set up any such ground of defence in his answer.

(*b*) As to the Swain Turbine and Manufacturing Company, in addition to the reasons just stated, it has been often held that an objection to the capacity of the plaintiff to sue *must be pleaded, or it is waived;* and if the defendant would take the ground that the plaintiff corporation was not properly organized, the objection is waived unless pleaded, and the weight of authority is that it should be pleaded in abatement; but the defendant has not set up this objection by plea or in his answer. The reasons which require the defendant to set up by plea or answer, the objection to the capacity of plaintiff corporation to sue for want of proper organization, apply with equal force, if he would rely on the same objection to its capacity to take and hold an assignment of a patent.

Storer et al. v. *Fay et als.*, 8 Off. Gazette, 558.

"Fourth. *For want of production of the memorandum of agreement, dated June* 2, 1874, *named in the said assignment of that date.*"

It is difficult to discover any reason for this objection. It is apparent, for two reasons, that there is no basis for this objection.

(*a*) The "memorandum of agreement" is not shown to be in the possession or under the control of the complainant. It is not proved to have been made in duplicate; and from the description given of

it in the assignment, it would be in the possession of the Swain Turbine Company, if in existence.

(*b*) It was absurd to notify complainant's counsel to produce a paper not in the possession or under the control of himself or of the complainant, but belonging to, and in possession of, another corporation.

The "conditions" referred to in the first line of the assignment (p. 26), are conditions subsequent and not precedent; and this fact, in connection with the absence of any evidence of non-performance of the conditions, is ample proof of title, so far as relates to this point.

Further, it is apparent from the testimony of Nichols that the conditions were fully performed, or waived long before the commencement of this suit. The conduct or non-action of the Swain Turbine Company, as shown in answers to Ints. 12–20, on page 28, is inconsistent with any other theory than the true one, that the conditions had been performed, or that they had been waived, or that no claim had been made on account of their non-performance. In either case, the title of the complainant would be good.

The proof tending to show performance of these conditions was introduced, *not* because it could be required of the complainant (the conditions being conditions subsequent), but to meet any captious objections which might be urged on the pretence of non-performance.

Titles by which patents are held, like other titles, should not be overthrown upon doubts or objections capable of reasonable and just solution in favor of their validity.

Blandy v. *Griffith*, 3 Fish., 609.

DEFENCES.

A bill in equity had been brought by the complainant against William Huntley, previously to the one against said Ladd, and the proofs had been partly taken and printed. On account of the sud-

den death of Huntley, the "agreement" was made, which appears on pages 8 and 9, commencing at 7*a*.

The defendant's answer does not appear in the printed record; but it is similar to Huntley's answer on pages 14–16, with the exception of one additional paragraph, which will probably not be relied on.

The answer sets up the following defences: —

1. That the "reissued Letters Patent were procured with fraudulent and deceptive intentions, and particularly with the intent to cover and claim, as the invention of said Swain, more and other things than those which were described and shown in said original Letters Patent, or were included in said Swain's original invention"; and that they "were in fact granted for more and other things and inventions than those which were described or shown in said original patent and in said original invention." (pp. 14, 12*a*.)

2. Priority of invention, as shown by sundry Letters Patent specified in the answer. (p. 15.)

3. Priority of use by sundry persons named in the answer. (p. 15.)

4. That the fifth claim in the reissued Letters Patent is for a result or function, and not for any mechanical means for its accomplishment, and that, therefore, the reissued Letters Patent are void. (pp. 15, 16, 13*a*.)

5. Abandonment by Swain, and dedication to the public, before the date of the reissued Letters Patent, of all portions of his invention referred to in the first, second, third and fifth claims. (p. 16.)

6. Denial of infringement. (p. 16.)

HISTORY AND DATE OF THE INVENTION.

The proofs show that Mr. Swain, the patentee, commenced giving attention to mechanics and hydraulics in 1844. (p. 129.) His duties were such as to require his continued investigation of these subjects;

and he was engaged in repairing, building, selecting, setting and running various kinds of water wheels from 1844 until 1855. The patented invention was conceived by him in the fall of 1855, and at that time was communicated to John M. Lovett. (pp. 130, 132, Ints. 9, 16–19; and p. 169, Ints. 12–17.) The letters written by Swain to Lovett, and the drawings sent to him in 1857 and 1858, while Lovett was in Minnesota, clearly show, not only that Swain then had the invention in his mind, but that he had communicated it to Lovett before he went to Minnesota.

See letter of Swain to Lovett, dated June 28, 1857, Exhibit J; letter dated March 30, 1858, Exhibit K; and drawings, Exhibits L, M and N, referred to on pp. 132, 133 and 169, 170.

Immediately after the conception of this invention, Mr. Swain commenced a course of reading and study to inform himself of the best proportions for sundry details as to requisite strength, &c., and to perfect himself in drawing. In August, 1856, he returned to the Lowell Machine shop to perfect himself in the art of mechanism and in turbine-wheel building. He continued there until the spring of 1859, devoting all the time he could spare, after his daily labor, to this subject. He made drawings and patterns for a six-inch turbine, which he experimented with in the summer of 1858. This wheel is introduced in evidence, and is marked "Exhibit I."

Isaac Austin, of Lowell, who witnessed some of the experiments with this wheel, contracted with Swain for a thirty-inch wheel of the same kind. Swain proceeded at once to make designs and patterns for the Austin wheel; and he had it completed, set up and running in Austin's mill in Lowell, in the month of December, 1858.

He constructed a dynamometer, and tested the power of this wheel in February and March, 1859. The wheel gave so good results that other parties gave him orders for wheels of the same size and pattern. During the year 1859 he constructed wheels of this size for John Holt, John Nesmith and A. J. Richmond & Co., all of Lowell; and also made his model for the Patent Office, for the purpose of securing his invention. He continued to work making wheels up to the time the patent was granted, May 15, 1860. (pp. 130, 131.)

The wheel made for Austin is introduced into the case, and is marked "Exhibit R." The wheel made for Nesmith is also introduced, and is marked "Exhibit S." (p. 142.) These wheels, and the others referred to, all gave good satisfaction. (pp. 133, 134.)

All of the wheels referred to as having been made by Swain are similar in their construction, operation and effect, and are also conformable to the invention conceived by him in 1855 and communicated to Lovett, as already stated. They are also, in their construction, operation and effect, similar to the wheels which have since been made under the Swain patent, and as shown in the original and reissued patent. There has, in fact, been no material difference or change in any of the Swain wheels made up to the present time. I do not refer to difference in size or perfection of finish.

Considering the difficulty attending the construction of the first Swain wheel, and the intricate calculations in order to determine the proportions of the floats and other parts of the wheel, so as to produce the best results, and considering also the circumstances in which Swain was then placed, no unreasonable time elapsed between the conception of his invention in the autumn of 1855, and the production of his first wheel. The reasons for this lapse of time appear in his answer to Int. 35, page 134.

It is therefore claimed that the autumn of 1855 should be taken as the date of the invention.

Philadelphia & Trenton R. R. Co. v. *Stimpson*, 14 Peters, 462.
Bartholomew v. *Sawyer*, Law's Digest, 450, § 61.
Winans v. *Damforth*, Id. 451, § 71.
Rev. Rub. Co. v. *Wing*, Id. 451, § 72.
Appletons v. *Chambers*, Id. 481, § 73.
Reed v. *Cutter*, 1 Story, 596.
White v. *Allen*, 2 Fish. 440.
Cox v. *Griggs*, 2 Fish. 174.
Woodman v. *Stimpson*, 3 Fish. 99.
Johnson v. *Root*, 1 Fish. 351.
Ransom v. *Mayor of N. Y.*, 1 Fish. 265.

UTILITY OF THE INVENTION.

The defendant admits the utility of this invention (p. 15); but the Court will not overlook the value and real merits of the invention. The sales of such wheels made by or for the complainant between the 2d of June, 1874, and February, 1875, amounted to thirty thousand dollars. (p. 28, Int. 14.) During the same time more wheels were made and sold by the licensees of the complainant than by the complainant. (pp. 30, 31, Ints. 13, 16.)

These wheels, in cheapness of construction, in ease of operation, great capacity, durability, and in effectively utilizing the power of the water, are shown by the proofs to be superior to any other wheels manufactured. They have been used by a larger number of prominent corporations than any other wheel, and they have uniformly given satisfaction. (pp. 135, 136, Ints. 49, 50.)

Hence it is to be expected that infringers, when sued, will spare no pains in their efforts to make a successful defence; and that they *may* resort to false testimony to this end.

TURBINE WHEELS.

Prior to the Swain invention there were in use two types of turbines.

One was the centre-vent turbine. In this, the water was discharged from the buckets towards the axis of the wheel. In some of the centre-vent turbines the water was discharged from the buckets nearly or quite horizontally; in others, at different angles below the horizontal line. The water, after leaving the buckets, was discharged into the space under the centre of the wheel, having for its

outer boundary the inner edge of the buckets. The buckets were curved and set at the proper angle between an upper and a lower crown, so as to utilize the power of the water in its passage through the wheel. The water was directed on to the buckets by or through a series of suitable guides; and the quantity of water to be used was regulated by a gate.

The other type of turbines referred to is the downward-vent or Jonval turbine. In this wheel the water was discharged from the buckets downwardly into the space under the buckets, forming, as it was discharged, a hollow cylinder of water; the outer and inner edges of the series of buckets being, respectively, at the same distance from the axis of the wheel as the outer and inner surfaces of the column of water from the centre of the hollow cylinder.

The buckets were curved and set at a proper angle, and attached to a cylindrical wall or band at the inner edges, (and generally to another band at their outer edges), so as to utilize the power of the water in its passage through the wheel. The water was properly directed on to the bucket by or through a series of suitable guides, and the quantity to be used was regulated by a gate.

This type of wheel was sometimes constructed so as to receive the water over or at the top of the wheel, as in the original Fontain and Nystrum wheels; and sometimes so as to receive the water on the outside, at the periphery of the wheel, as in the Burnham and Whitney wheels. In some of the Jonval or downward-vent wheels the discharge edges of the buckets were horizontal; in others they were cut away on the outside edges of the buckets, and in others they were cut away on the inside edges, as shown in the Burnham and Whitney wheels.

These two types of turbines, the centre-vent and the downward-vent, have been fully described in the proofs in this case, and must be also well known by the Court as matters of common knowledge.

In the Swain turbine are united the elements and properties of these two types of turbines, together with other valuable features, having its buckets so formed and the other parts of the wheel so constructed and arranged that it has an effective inward flow, and discharge of part of the water, and an effective downward flow, and discharge of part of the water simultaneously; thus increasing the effective capacity of the turbine without increasing the diameter of the wheel.

It has the crown over the top edges of the buckets, forming an upper boundary or wall to hold the water in the buckets while its power is being utilized, and connecting the buckets with the shaft by means of the coupling. The upper portions of the buckets are curved, and they are set at a suitable angle to receive and utilize the power of the water which is directed on to them by a series of guides as in a centre-vent turbine. It has the space or area in the interior of the wheel, below the crown, and bounded by the inner edges of the buckets, into which the water is discharged from the upper portion of the buckets and thence passes off as in a centre-vent turbine, without occupying any of the space immediately under the buckets.

It has the following properties of the various downward-vent or Jonval turbines.

It has the lower portion of the buckets curved from a vertical towards a horizontal direction, and set at such an angle as to utilize the power of that part of the water which passes through the lower portion of the turbine. It has the annular space or area under the buckets, into which the water, discharged from the lower portion of the buckets, is received and thence passes off, as in the Jonval turbines, without occupying any of the space under the coupling of the wheel and within the inner edges of the buckets.

The buckets are set at the proper angle, and are connected with the shaft of the wheel by arms or a coupling plate and hub, which

are secured to that part of the crown to which the buckets are attached, to secure them in position. A contiguous series of guides is so arranged as to properly conduct the water on to the buckets; and the quantity of water to be used is regulated by a gate.

There can be no doubt that the Swain wheel is the best now in use. This is shown by the tests proved in this case, and by its being used in preference to any others by parties and corporations that would unquestionably select the best wheels to be found (p. 135, Int. 49.)

The Court will therefore so construe the patent as to give the inventor and his assigns the full benefit of the invention, unless there has evidently been a violation of law in obtaining a reissue, or unless it has been proved that Swain was not the first and original inventor of his patented wheel.

THE REISSUE.

The original patent was granted for the invention of "a new and improved water wheel." The specification, drawings and model of the original patent, taken together, clearly describe and show the construction and operation of the patented wheel.

When the reissue was granted, the Act of July 8, 1870, was in force. This act contains some provisions and restrictions not found in the Act of 1836; but these additional provisions do not apply to *this* case. Hence the decisions regarding the construction of the Act of 1836 are applicable to the Act of 1870, so far as the last named act affects the case at bar.

Prima facie it must be presumed that the amended or reissued patent was properly and rightfully granted by the commissioner.

Allen v. *Blunt*, 3 Story, 744.
Allen v. *Blunt*, 2 Wood & Min. 138.
O'Reilly v. *Morse*, 15 How. 112.
Hussey v. *Bradley*, 2 Fish. 362.

In a suit against an infringer, the proceedings before the Commissioner of Patents in the surrender and reissue of a patent are not open for consideration.

The only matters open are (1) whether, in case of a machine patent, there was any amendment of the model or drawings except each by the other; and (2) whether any new matter was introduced into the amended specification.

And whether any new matter was introduced into the amended specification is to be determined by the Court upon examining the specification, claims, drawings and model of the reissue and of the original patent, and comparing them together. No testimony of experts or of other persons as to their similarity or dissimilarity is admissible.

16 Stat. at Large, ch. 230, § 53, Act of July 8, 1870.
Gear v. *Grosvenor*, 6 Fish. 316.
Eureka Co. v. *Bradley*, 11 Wallace, 489.
Rubber Co. v. *Goodyear*, 9 Wallace, 796, 798.
Johnson v. *Beard*, 8 Off. Gazette, 436.
Battin v. *Taggert*, 17 How. 84.
Middletown Tool Co. v. *Judd*, 3 Fish. 141.
Seymour v. *Osborne*, 11 Wallace, 542, 543.
Carew v. *Elastic Fabric Co.*, 5 Fish. 90.
Black v. *Thorne*, 5 Fish. 550.
Seymour v. *Marsh*, 6 Fish. 115.
Murphy v. *Eastman*, 5 Fish. 309.

The rule for determining the validity of a reissued patent restricts the inquiry to a comparison of the terms and import of the original and reissued Letters Patent, and a consideration of the Patent Office drawings and models. If from these it results that the invention claimed in the reissue is substantially described or indicated in the original specification, drawing or model, the very case for which the Act of Congress was intended to provide is shown to exist; and any change in the description or claims which is necessary to effectuate the invention, is within its sanction.

It is no objection to the validity of reissues that their claims are broader than those of the original patents.

If the reissued patent does not, upon the face of the patent, embrace anything not substantially described or suggested in the original, the reissue is valid.

Black v. *Thorne*, 5 Fish. 550.
Seymour v. *Marsh*, 6 Fish. 115.
Wells v. *Gill*, 6 Fish. 574.
Swift v. *Whisen*, 3 Fish. 353.

"Reissued patents are presumed to be for the same invention as the original, and will only be adjudged to be void because for a different invention where it clearly appears that the reissue contains some new feature of a material character not described, suggested, nor substantially indicated in the specification, drawings or Patent Office model."

"Authority to accept the surrender of an original patent and to grant a reissue is conferred upon the commissioner; and, in a case arising under the patent law then in force, the Supreme Court, more than thirty years ago, decided that where an act was to be done, or a patent granted upon proofs to be had before a public officer upon which he was to decide, the fact that such officer had done the act or granted the patent was *prima facie* evidence that the proofs had been regularly made, and that they were satisfactory, even though the patent did not contain any recitals that the prerequisites to the grant had been fulfilled; and such continued to be the rule until the question came up under a later act, when the Supreme Court held that the granting of a reissued patent closed all inquiry into the existence of inadvertence, accident, or mistake, and left open only the question of fraud for the jury. *Railroad* v. *Stimpson*, 14 Pet. 458; *Stimpson* v. *Railroad*, 4 How. 384. Since that time it has been definitively settled that neither reissued nor extended patents can be abrogated by an infringer in a suit against him for damages or profits, upon the ground that the Letters Patent were procured by fraud in prosecuting the application for the same before the commissioner. *Rubber Co.* v. *Goodyear*, 9 Wall. 797. Where the commissioner accepts a surrender of an original patent, and grants a new patent, his decision in the premises, *in a suit for infringement*, is final and decisive, and is not reëxaminable in such a suit in the Circuit Court, unless

it is apparent upon the face of the patent that he has exceeded his authority; that there is such a repugnancy between the old and the new patent that it must be held as matter of legal construction that the new patent is not for the same invention as that embraced and secured in the original. *Seymour* v. *Osborne*, 11 Id. 543.

Power to accept the surrender of an original patent, and to grant a new one in its place, is conferred upon the commissioner, but the act of Congress giving that power expressly requires that the reissued patent must be for the same invention as the original. Patents may be surrendered to be corrected, and the power to surrender implies that the specification may be corrected to the extent necessary to cure the defects and to supply the deficiencies to render the patent operative and valid; but the patentee may not interpolate new features not described, suggested or substantially indicated, either in the specification, drawings or Patent Office model. Interpolations of the kind, if material, show that the commissioner exceeded his jurisdiction, and where that is done it clearly becomes the duty of the Court to declare the patent void. Courts of justice will avoid such a conclusion if they can reasonably do so by a proper application of the maxim that patents are to receive a liberal construction, and, if practicable, be so interpreted as to uphold and not destroy the right of the inventor. *Turrell* v. *Railroad*, 1 Wall. 491; *Amos* v. *Howard*, 1 Sum. 482; *Blanchard* v. *Sprague*, 3 Id. 335; *Glue Co.* v. *Upton*, 6 Off. Gaz. 839. Slight changes will not sustain such a defence; nor will the Court in any case declare the patent void on that account, if, by the true construction of the two instruments, the invention secured by the reissue is not substantially different from that embodied in the original patent. Enquiries in such a case are restricted to a comparison of the terms and import of the two patents in view of the drawings and Patent Office model. If from these it results that the invention claimed in the reissue is not substantially different from the one described, suggested, or indicated in the specification or drawings of the original patent, or Patent Office model, the reissued patent must be held valid, as all other alterations and amendments plainly fall within the intent and purpose of the provision in the act of Congress which allows a surrender and reissue; or, in other words, if the reissued patent does not, upon the face of the instrument, embrace anything not substantially described, suggested or indicated in the specifications, drawings or model of the original, the defence that the reissued patent is not for the same invention as the original, must be overruled."

Per CLIFFORD, J., in *Haskell et al.* v. *Shoe Mach. Mfg. Co. et al.*, 15 Off. Gaz. 509.

The defendant objects to the validity of the reissued Letters Patent for the alleged reasons that they were fraudulently obtained, and that they fraudulently included more and other things than were invented by Swain or shown in his original patent.

This defence is not open to the respondent in this form of action.

There is not only no presumption and no proof of fraud, but the proofs in the case exclude all ground for even the slightest suspicion of fraud.

One of the matters principally relied upon by the defendant is the omission in the specification of the reissue of the statement in the specification of the original patent near the top of page 20, as to the curvature of the rim or crown and its effect upon the water as it enters the wheel.

A curved crown was not an invention of Swain's, nor is the *curvature* of the crown an essential element in the Swain wheel. Before he applied for his patent he constructed wheels and made drawings, some of which had crowns which were horizontal, or very nearly so, and others having crowns somewhat curved. This appears by reference to the drawings he sent Lovett in 1858, Exhibits L, M and N, in which the crowns were curved; the six-inch wheel, Exhibit I, made in 1858, having a horizontal crown; the Austin wheel, Exhibit R, made also in 1858, with a curved crown; and the Nesmith wheel, Exhibit S, made in 1859, with a crown nearly horizontal.

It was also well known that in centre-vent wheels there was no substantial difference in effect between a wheel with a horizontal crown and one with a curved crown, or one with its crown dropping

as it approached the centre of the wheel; one being a well-known substitute and equivalent for the other at date of Swain's invention. (pp. 142, 143, Ints. 95–97, 98, 99; p. 185, Ints. 29–31; p. 199, Ans. 12.)

The model filed with the application for the original patent was not made to a scale, and was merely for the purpose of showing substantially the form and construction of the Swain wheel. (p. 145, Int. 107.)

The application, specification and drawings were prepared by Munn & Co., of New York city. Swain sent them the model, a duplicate of Exhibit E, and a writing of what he thought was new in it. He did not request to have "any such specification or statement, either in its language or in its substance," inserted in the schedule. He explains fully and satisfactorily how it happened that he signed the application without a critical examination, when he first discovered the erroneous statement, and the cause of the delay, in obtaining the reissue. (pp. 144–146.)

The object of the act of Congress referred to, is to provide for cases of just such inadvertence and mistake; but even without this explanation, such an omission in the reissue does not affect its validity.

Carver v. *Braintree Mfg. Co.*, 2 Story, 439.

The Act of July 8, 1870, provides that in case of a machine patent neither the model nor drawings shall be amended, except each by the other.

If the defendant would claim that the reissued Letters Patent are

invalid by reason of the violation of this provision, he should distinctly set up this defence in his answer. This has not been done, and the objection is not open to him.

But if it should be held that this point may be considered under the defendant's answer, the question whether any such amendment has been made in the drawings as is prohibited by that act, is to be determined by the Court from a comparison of the drawings of the reissued Letters Patent with the drawings of the original, and no extrinsic evidence can be introduced on this point. (See cases already cited.)

By such comparison, it is evident that the drawings of the reissued patent are exactly like the drawings of the original, being, in fact, tracings from the original.

The defendant examined Henry B. Renwick on this point; but his testimony is inadmissible and was objected to, among other reasons, "because the Court is to determine from examination and comparison of the patent and reissue and their drawings." (p. 121, Int. 3.)

But if the testimony of Renwick on this point is to be received, its inaccuracy is so fully shown as to discredit his testimony upon other points in the case. He says that "The drawings of the reissue and original, judging by the eye, differ from each other in the form and proportion of the crown and hub with reference to the other parts of the wheel. In the reissue, the crown is not so much bent downward as it is in the original patent, and the hub is smaller in proportion," &c. (p. 122.)

(*a*) By comparing the drawings of the reissue with the drawings of the original, the Court will see that there are no such differences as Renwick states.

(*b*) Swain testifies that no change was made in the drawings at the time when the reissue was obtained; that they were as nearly like the drawings upon which the original patent was granted, as it was practicable to make them. (p. 135, Ints. 42, 43.)

(*c*) This statement is confirmed by Mr. Hibbard. (p. 177, Int. 6; also, p. 178, Int. 10.)

The model sent to the Patent Office with the application for the original patent is the same, with no change or amendment. A duplicate of this model is in the case, Exhibit E, and although not nicely finished clearly shows the invention of Swain, as described in the specification and claims in his reissued Letters Patent. (p. 134, Int. 41; p. 145, Int. 107; p. 179, Int. 12; p. 303, Int. 12.)

Do the specification and claims of the reissued Letters Patent include more than is shown and claimed in the original patent, taken in connection with the drawings and model?

Who shall determine this question? If the Court, as has been repeatedly decided, it is confidently asserted that by a careful examination of the original patent with its specification, drawings and model, and by a comparison of the same with the reissue, it will be seen that nothing is described or claimed in the reissue which is not described or shown in the original.

If this question is to be determined by testimony, the result must be the same.

In either case, *prima facie*, the decision of the Commissioner is to be taken as correct, and the reissue held valid.

To invalidate the reissue the defendant relies on the testimony of Henry B. Renwick as an expert. His testimony was objected to on the ground that he was not shown to be a competent expert in such matters as are involved in this case. He says, "I am by profession a civil and mechanical engineer, and principally occupied at present in the examination of machinery and patents; and I am frequently examined as expert in suits in which patents are in question." (p. 121.)

On cross-examination, when recalled by defendant, he testified that he never made or assisted in making, never designed or assisted in designing, a turbine water wheel for practical use; that he never tested any turbine water wheels; that he never operated such a wheel in any mill, or in connection with any mill; and he cannot give the name of any work or book which he ever read or studied relating to turbine water wheels. (pp. 207–208, Cross-Ints. 9–12 and 19.)

He attempts to point out differences between the specification and claims in the reissue and those in the original patent. Of course differences will exist, otherwise there would be no occasion for applying for a reissue. The matter to be determined is not whether the specification and claims in the reissue are like the specification and claims in the original, but whether they include or claim any invention not described or shown in the specification, drawings and model of the original patent.

Without minutely examining the testimony on this point, it should be noted that although a duplicate of the model in the Patent Office is in the case, and Renwick's attention called to it, *he does not state or intimate that the model does not exhibit or show such a wheel as Swain claims to have invented, and as is described and claimed in the reissue.*

On this subject the complainant's experts, Mr. Swain and Mr. Hibbard, are practical mechanics, and have been long and intimately acquainted with the making and operating of turbine water wheels, and their testimony is in direct conflict with the opinion expressed by Renwick. We refer only to portions of their evidence. (Hibbard's evidence, pp. 176–180 and 185; Swain's evidence, p. 144, Int. 106; p. 151, Ints. 135, 136.)

Additional and conclusive evidence of the fact that nothing is

claimed in the reissue which is not described or shown in the specification, drawings, and model of the original patent, is to be found in the fact that not a wheel has been made by or for Swain by any of the assignees or licensees under the reissued patent, which includes any invention or matter not found in the wheels made by Swain at the date of his original patent, and not described or shown in the specification, drawings or model of the original patent.

Complainants' Exhibits, I, L, M, N, R, S, show Swain's invention was substantially that shown and claimed in the reissued patent. The proofs show this in the testimony of Swain, Hibbard and Waters. Respondent makes no objection to this testimony, nor does he offer any proofs respecting these exhibits.

It has been suggested in defence that the fifth claim in the reissue, (p. 22), is a claim for a function or result, and not for a mechanical contrivance; but this claim is to be taken in connection with the specification, drawings and model, and is thus sufficiently clear and explicit to be free from the objection suggested. (Hibbard's evidence, p. 177, Int. 7.)

Mitchell v. *Tilghman*, 19 Wall. 287.

A more extended investigation of the testimony of Renwick, Swain and Hibbard, would only show more fully the validity of the reissue.

In the latter part of this brief I shall introduce some drawings illustrative of different kinds of turbine wheels, and of some of the wheels touching which testimony has been introduced in this case.

PRIORITY OF INVENTION.

The defendant, in his answer, alleges that the Swain invention was anticipated by the inventions described in ten Letters Patent specified on page 7. He introduces three, only: No. 10,916, granted to Abel Greenleaf, May 16, 1854; No. 42,708, granted to Waldo Whitney, May 10, 1864, and No. 22,902, granted to John Temple, Feb. 8, 1859.

THE GREENLEAF PATENT.

This appears on pages 208–212. It is for "improvements in gravity and percussion water-power machines." He limits his invention to certain claims found on page 212.

There is no proof in the case that any wheel was ever made under or in accordance with this patent.

Under such circumstances, whether it anticipates the Swain invention is to be determined by the Court, by comparing it with the Swain reissue and the exhibits in the case showing the wheels made in accordance with the Swain patent; and if, on such comparison, the Court should not be satisfied "that any mechanic of ordinary skill could, from the description in the first patent, construct or supply all the essential parts of the mechanism described in the second patent," the first patent will not render the second invalid.

Union Sugar Refinery v. *Matthiessen*, 2 Fish. 608.
Curtis on Patents, § 378*a*.
Parker v. *Stiles*, 5 McLean, 61.
Hamilton v. *Ives*, 6 Fisher, 253.
1 Fisher, 265.
Clark Pat. Steam & Fire Regulator Co. v. *Copeland*, 2 Fish. 222.
Woodman v. *Stimpson*, 3 Fish. 98.

Upon such comparison, it is believed the Court will not hold that the Swain invention was anticipated by the Greenleaf patent.

If expert testimony should be received, the proofs show conclusively that the Greenleaf patent does not anticipate the Swain invention.

For Renwick's testimony touching the Greenleaf patent (which was objected to by complainant at the end of Int. 6, on page 125), see page 126, and Cross-Int. 13 on page 207.

Whether a wheel made in accordance with this patent would work, is wholly speculative. Judging from all the data furnished by the patent, it is very doubtful whether it could be used for *any* practical purpose. It has not the properties of a turbine, and it could not possibly operate like a turbine. In mechanical construction, in arrangement of its details, and as an entirety, it is unlike Swain's invention.

The speculative testimony of Mr. Renwick, that if certain changes or alterations were made in the Greenleaf contrivance it would resemble Swain's, is not admissible; and, if admissible, the suggestions are of no importance, except as showing the persistent determination of Mr. Renwick to defeat the complainant, if possible, and the estimation in which *such* kind of expert testimony should be regarded.

See, also, testimony of Swain, pages 148, 149; Hibbard's testimony, page 183, and Waters' testimony, page 195.

A machine which has no useful capacity for the performance of the function of a patented machine, and which stops short of that

function, does not anticipate the patented contrivance, although it may be a near approach to it, and although it may have been very suggestive to an ingenious mind already conversant with the art.

Waterbury Brass Co. v. *Miller*, 5 Fish. 48.
Bussey et al. v. *Wager*, 9 Off. Gazette, 301.
Stillwell & B. Manuf. Co. v. *Cincinnati Gas Co.*, 7 Off. Gazette, 829.
Ransom v. *Mayor of N. Y.*, 1 Fish. 265.

As to the Greenleaf patent, the evidence is plenary, that the Greenleaf wheel has no useful capacity for the performance of the function of Swain's patented wheel; that it does not approach it; and even if it had been known by Swain at the time of his invention, (as it was not), it could not have been suggestive.

THE WHITNEY PATENT.

The Whitney patent is not mentioned in defendant's answer, but it is agreed on page 91, 7*b*, that it may be introduced without objection; "and that said Whitney, as early as Aug. 1, 1856, made and reduced to practice a wheel, such as is described in said Letters Patent, and sold it to Jotham Hartshorn, of Amherst, N. H., and it was put into operation by him in a saw-mill in May, 1857, and so used until October, 1875, and large numbers of such wheels have been made and used."

The patent is dated May 10, 1864, and is on pages 213, 214. The wheel referred to is "Complainant's Exhibit T." (See p. 142, Int. 93; and Hartshorn's evidence, pp. 175, 176.)

There are several answers to this attempt by defendant to anticipate Swain's invention.

(*a*) It has been already shown that the date of Swain's invention may properly be regarded as in the year 1855. (pp. 8–10 *ante*.)

(*b*) On examining the patent and the wheel, Exhibit T, and comparing the same with the Swain reissue and any of the wheels made under it or under Swain's original patent, or in accordance therewith, the Court cannot fail to determine at once that there is no ground for the assumption that the Whitney patent or wheel anticipates Swain's invention.

(*c*) The testimony of Swain on pages 149–150, the testimony of Hibbard on pages 183–184, and the testimony of Waters on pages 196–198, also show beyond doubt that the Whitney patent and wheel do not anticipate Swain's invention.

Renwick, as might be expected, in his testimony on pages 124–126, makes a feeble effort to assimilate the Whitney patent with the Swain invention; but his testimony is utterly refuted, not only by the testimony of Hibbard, Swain and Waters, but by mere inspection of the Whitney and Swain patents, and of the wheels made in accordance with them and introduced in evidence.

(*d*) Whitney is alive, and was easily accessible by the defendant. It is apparent from the proofs that, if not in collusion with the defendant since this suit was commenced, he has been on friendly terms with him, ready to aid him, and to go with him to distant places to point out and show him wheels made by him prior to the date of his patent, and claimed by him to be in accordance with his patent.

(*e*) It does not distinctly appear at what time the stipulation was made which is referred to. It is printed on pages 8 and 9 of the Record, and on its second page it is stated that "said Whitney, as early as August 1, 1856, made and reduced to practice a wheel such as is described in said Letters Patent, and sold it to Jotham Hartshorn, of Amherst, N. H., and it was put into operation by him in a

saw mill, in May, 1857, and so used until October, 1875, and large numbers of such wheels have been made and used. This wheel is now in plaintiff's possession, at Lowell. The defendants may have reasonable opportunity to examine the wheel, and recall and examine their expert touching the wheel, before the plaintiff's take their rebuttal expert testimony."

It is proved that in March, 1875, the defendant and Whitney went to Amherst, N. H., and to the saw mill where this wheel then was, and that the wheel was so situated that it could be seen. (Evidence of Hartshorn, pp. 175 and 176.)

It is not conceivable that Ladd went to that saw mill in Amherst, and had Whitney go with him, except for the purpose of examining that wheel and having it identified by Whitney, in order to fix the earliest date they could of the invention of Whitney's patented wheel. This inference from the testimony is so obvious that, if such had not been the object, the testimony of Ladd or Whitney to that effect would have been introduced.

It is a part of that stipulation that "large numbers of such wheels have been made and used," that is, *such wheels as this Hartshorn wheel;* and such stipulation would not have been entered into in behalf of defendant, unless he had carefully examined and perfectly understood the Hartshorn wheel.

(*f*) It appears that Whitney continued to make wheels under his patent like the Hartshorn wheel, Exhibit T, — which, as before stated, is not like Swain's, and does not anticipate Swain's invention, — until after he had seen the Swain wheel tested and had had his own wheel tested, and until after a drawing of the Swain wheel had been left in his shop by Sargent. (p. 152, Ints. 144 and 145; pp. 171–173.) He then made a different wheel, an infringement of Swain's patent, (p. 152, Int. 144), and issued his circular and descriptive pamphlet, "Complainant's Exhibits A', B', X and C*c*."

His infringement being detected, he took a license from the complainant, in which he distinctly admitted the infringement, and agreed

to pay royalty on such wheels thereafter made by him. A duplicate of the license, "Complainant's Exhibit C[1]," was introduced as evidence without objection. (p. 152, Int. 147.)

THE TEMPLE PATENT.

This patent is on pages 214–215. It is dated Feb. 8, 1859. It does not invalidate Swain's patent, for the following reasons: —

(*a*) It is of a later date than Swain's invention, whether the Court should consider the date of his invention as being in 1855, as hereinbefore claimed, or in the summer of 1858, when Swain made the six-inch wheel, Exhibit I, or in December, 1858, when he completed and set at work the Austin wheel, Exhibit R. The last date, December, 1858, is the very latest date at which the Swain invention can be placed.

Swain, pp. 130–131, Int. 10.
Sargent, p. 170, and
Clarke, pp. 173–174.

(*b*) On comparing the Temple patent with the Swain invention, its dissimilarity is apparent.

(*c*) *As the date of this patent is since the Swain invention, the only purpose of examining the expert testimony touching this patent is to see what effect such examination will have upon the confidence which may be reposed in the other testimony of the same experts.*

Swain states (p. 150) that for reasons given by him, the wheel described in the Temple patent "is inoperative as a turbine, and what he describes in his patent is impossible and absurd."

Renwick states on (pp. 125–126) that "*the wheel described in this patent*" he has "*been familiar with for several years.*" And he

endeavors to make it appear that "it is substantially identical with the Swain original patent," with two exceptions.

A proper inference from his testimony would be that wheels made under the Temple patent were in common use, and that he had frequently seen them in use. His testimony above quoted amounts to that. But after we had proved that "the only wheel ever built under this patent by the inventor wouldn't work, and proved an entire failure, and was abandoned by him," (p. 150), *he was forced to admit substantially that he had never seen any such wheel!* (p. 207, Cross-Ints. 17, 18.)

As bearing upon the reliability of Renwick as an expert witness in this case, it is proper to consider his testimony touching the Leffel wheel, (p. 123), which he volunteers, unasked for. He says that the Leffel wheel is in fact a combination in one wheel of a Fourneyron, or centre-vent, and a Jonval turbine; and he asserts in his testimony that by an omission in the specification in Swain's reissue of a statement that the crown is curved, which statement appears in the specification of the original patent, Swain changed the patent; and that *with the crown curved, as described in the original patent, it would be impossible to combine in one wheel a centre-vent and a Jonval turbine.* The apparent object of Renwick in this erroneous statement was to convince the Court that fraud had been practised in obtaining the reissue. Evidently, Renwick did not anticipate the testimony afterwards introduced by complainant. See Swain's testimony, page 144, Ints. 103, 104; and Hibbard's testimony, page 181; also, certified copy of the drawing of Leffel's reissue, Exhibit V; from all which it appears that *the crown in the Leffel wheel instead of being horizontal is curved, and that Renwick is guilty of the glaring absurdity of stating that a curved crown, if made by Swain, makes it impossible to unite in one wheel a centre-vent and Jonval turbine, but is no obstacle to such a result if made by Leffel.*

It further appears from the testimony referred to that the Leffel wheel infringes the Swain patent.

PRIOR USE.

The defendant in his answer alleges, on information and belief, that all the material and substantial parts of the combinations and contrivances described in the reissued Letters Patent were known to and used by ten persons named, in various places in three different States.

Besides the Whitney wheel, which has been considered in connection with the Whitney patent, no proof has been introduced except in relation to wheels said to have been made by John L. Stowe, one in 1837, one in 1841 and one in 1850.

From the efforts made by the defendant to establish priority of invention, it is apparent that his chief reliance is upon this part of his defence.

It is claimed on behalf of the complainant, that the proofs offered by defendant are unreliable and fail to establish the facts as alleged by him, and that, if they were established, they would not invalidate complainant's patent.

The defendant's principal witness is Stowe. He is fifty-five years old. He resides in Newark, N. J. He claims to be a "millwright and engineer, and also builder of water wheels." (p. 38, Int. 1.) He went to New Jersey in 1860. (pp. 38, 39, Cross-Ints. 138, 139.) He introduces a wheel, Exhibit 1, made by him. (p. 38, Int. 3.) He has made, including this wheel, eight similar turbines. The order for the *first* of these was received in the fall of 1873. (p. 44, Ints. 71, 72, and p. 49, Cross-Ints. 141, 142.)

About the time he made the first of these eight wheels, doubtless just before that time, he saw in New York the "Climax wheel." (p. 44, Int. 70.) *The "Climax wheel" was an infringement of the*

Swain wheel, manufactured by the Newburg Steam Engine Company, which has since requested and obtained a license from the complainant. Prior to seeing the "Climax wheel," Stowe had been engaged in New Jersey in the manufacture of wheels; but, up to that time he had not attempted to make a wheel of this description. He admits that, if the validity of the Swain patent should be established, he would be liable as an infringer by the manufacture of these eight wheels. (p. 73, Cross-Int. 445.) He has accordingly united his efforts with the National Water Wheel Company of Bristol, the real defendant in this case, for the purpose of defeating the Swain patent.

The agent of that company called on him at Newark. (p. 54, Cross-Int. 207.) What arrangements were made by them does not appear. Since May, 1875, he has voluntarily come into the New England States three times for the purpose of testifying or giving information in aid of this defence; has voluntarily furnished sketches for models, and has been with the defendant to Vermont to find and to talk with witnesses. (p. 53, Cross-Ints. 438–445.)

Stowe's age, and knowledge — or rather his ignorance — of mechanics and of water wheels, in 1837, when he says he made "a water wheel of the kind contained in Exhibit 1," render it improbable, if not incredible, that he could then have made or could even have had the idea of any such wheel. (p. 38, Int. 4; p. 39, Ints. 11–15.)

He was at that time but seventeen years old. He was brought up on a farm in the interior of Vermont. He had never seen a turbine wheel, and had no information touching turbines. He had never made or assisted in making any water wheel. He had made ox-carts, yokes, cart-wheels and ox-sleds, and had done something at framing buildings, and during a part of one fall at making cider mills. This comprises all the practical knowledge he then had of mechanics. (pp. 51, 52, Cross-Ints. 171–182.)

His contradictory and absurd statements touching these three wheels show that no confidence can be placed in his testimony.

He says the model, Exhibit 2, was constructed *under his direction;* and that it correctly exhibits the wheel he made in 1837, and shows substantially all the proportions of that wheel, and in respect of the discharge line of the floats is identical with that wheel. (pp. 39, 40, Ints. 6–9, 16.)

This exhibit was, in fact, made at Bristol, by the National Water Wheel Company, the defendant in interest, not under the direction, but in the absence of Stowe. (pp. 54, 55, Cross-Ints. 207–224.) In answer to Cross-Ints. 209 and 210, he says he gave instructions or directions to Mr. Shepard at Bristol, who made a sketch for the wheel.

Stowe *never* had any drawings, memoranda, minutes, description or statement of dimensions of the 1837 wheel. (pp. 50, 51, Cross-Ints. 161–168.) *And it is incredible that in* 1875 *he should be able to give the exact dimensions of the wheel and of its different parts as he testifies.*

He also swears to the exact size and dimensions of the wheels made by him in 1841 and 1850, with no means of enabling him to do so. He states that the models, Exhibits 2 and 3, correctly represent those wheels as to their proportions, construction and principles. (pp. 40–43.) *This is not to be credited. The models were made by the defendant's company, and in the absence of Stowe; and the sketches used in making the models were made by the company, or its agents, or with their aid, as appears by the proofs.*

The shafts of these two models, Exhibits 2 and 3, extend downward only just below the under surface of their rims.

No model of the 1850 wheel was introduced in the direct testimony;

but Stowe, in answer to leading questions, describes this wheel, or rather assents to the description contained in the questions, and states wherein it differed in its construction from the wheels of 1837 and 1841. (pp. 41, 42, Ints. 39–46.) He says he has given "all the respects in which it differed from Exhibit 3," (Int. 46); *and he does not indicate any difference in the shaft.*

It is evident that if the shafts extended downward to the lower edge of the buckets, the space in the interior of the 1841 and the 1850 wheels, between the shaft and the inner edges of the buckets, would be so small as to prevent any effective inward flow of the water.

The construction of the shafts shown in Exhibits 2 and 3, with Stowe's testimony that it correctly illustrated the wheel of 1850, was a deceptive imposition upon the Court which Stowe, himself, was obliged afterwards to correct.

On the 31st of July, 1875, the taking of his testimony was adjourned to August 2. (p. 55.) Up to that time there was no intimation that the shaft had not been correctly shown in Exhibits 2 and 3. The taking of his testimony was resumed August 12. (p. 55.)

In the meantime it had been shown in the cross-examination of Sumner B. Small, on the 3d of August, (pp. 86, 87, Cross-Ints. 119–134,) and by the cross-examination of William Weeden, on the 11th of August, (pp. 101, 102, Cross-Ints. 110–131), that the lower end of the shaft extended nearly as far down as the lower edge of the buckets.

Thereupon, a new model, Exhibit 7, was made, and, against complainant's objection, put into the case. (p. 108.) And Stowe was constrained to admit, *contrary to his direct testimony*, that the shaft extended downward, substantially as stated by Small and Weeden. (p. 65, Cross-Ints. 348–353.)

Certain sketches and plans were also introduced by Stowe. Exhibit 4 was offered for the purpose of showing that as early as

March, 1850, when he was putting in the 1850 wheel, he was making that wheel with the idea that it contained some such elements as he now pretends it did; namely, of capacity for inward and downward discharge of water.

We here state with confidence that *this drawing had no connection with the* 1850 *wheel, and was not made until long after that date.* We refer to cross-examination of Stowe, (pp. 44–46), and to the evident alteration in the date on the drawing.

Stowe introduces drawing, Exhibit 5, which he states was made in Hartland, Vt., in 1859. (p. 43, Ints. 60–62.) This exhibit is in pencil, and on it is written, in pencil, "This made June, 1859, in Hartland, Vt., by John L. Stowe."

See his cross-examination touching this drawing on page 50, and a careful examination of the parts of the drawing referred to will satisfy the Court, that *the writing upon it was not made at or about the time of the drawing, but was placed there for deceptive purposes.*

If the other drawings and sketches introduced by Stowe, being "Exhibit Sketch of 1837 Wheel," "Exhibit Sketch of 1841 Wheel," and Exhibit 6, could have any important bearing in this case, it is for the Court to determine what reliance can be placed upon them.

Stowe states, (p. 60) that his 1837 wheel was of twenty-five to thirty horse power, and the 1841 wheel about five or six horse power, and his 1850 wheel of six or seven horse power.

Considering the head of water and the quantity used, no other wheels ever made or heard of were of such power; and yet Stowe made no attempt to make or to induce others to make any other wheels of this description, nor did he apply for any patent, although, according to his testimony, he was engaged in making wheels of other descriptions, and built two for himself in 1854–5, of the

Howd improved kind, — *costing much more and being greatly inferior to the wheels he made in* 1837, 1841 *and* 1850, *if his story is truthful.*

On page 36*a* are illustrative drawings, to a scale, of the wheel introduced by Stowe, of the "*turbine*" first made by him in 1873. (p. 44, Ans. 70, 71 and 72; p. 49, Ans. 141 to 149 inclusive.)

He says he first saw a wheel like Swain's about same time he took the order for *this* wheel in 1873. (Ans. 70, 71, 72.) He acknowledges himself an infringer of the Swain patent by making this wheel. (Ans. 445.) The Exhibit I shows in all its details every property of the Swain turbine as claimed in said reissued patent, No. 5,154, in clauses of claim 1, 2, 3 and 5. It is not well proportioned throughout, but possesses each element of Swain's invention. It has a bucket with its upper part of centre-vent form, service and discharge opening, with space for the discharged water to enter into and pass off, substantially same as in the upper part of complainant's turbine, and in any centre-vent turbine, coupled with its lower part formed like a Jonval bucket or Swain's patented turbine, with surface, discharge edge and place under the bucket for the discharged water to enter into and pass off substantially the same as characterizes Swain's or the Jonval turbine; also, a circular series of contiguous guides to direct the water properly on to the turbine.

Stowe assists in this defence voluntarily, going from place to place at much expense for witnesses, and furnishing evidence for respondent. (His 440, 441, 442, 443 answers.)

Stowe calls this a "*turbine.*" (Fifty-second answer.) In no instance does he call his alleged 1837–41 and 1850 wheels turbines. This Exhibit I hasn't a single property or element characterizing his other three wheels.

Particular attention is called to this Exhibit I, as showing the infringement by Stowe of complainant's patent. This, together with his testimony acknowledging his infringement, (four hundred and forty-fifth answer), shows his interest or prejudice as a witness.

The figure on page 37*a* is reduced by scale from the respondent's "Exhibit Sketch of 1837 wheel" (Stowe's wheel).

Stowe says this was drawn to a scale; that model Exhibit 2 was made from it, and that it *exactly* represents in all its details his 1837 wheel.

In his one hundred and ninety-seventh answer he says this spout was 6 inches broad horizontally and 12 inches in vertical height at the end where it discharged on to the wheel, and 12×15 at flume end, and ten feet long. Now apply these figures to this sketch by "scale of one inch to foot," and we find the spout is represented by the blue lines, and not by the black lines, as made by Stowe, covering one bucket instead of two.

Stowe, in his two hundred and eighty-sixth answer, says this wheel made fifty revolutions per minute. We also know, (p. 136, Ans. 52), that such a spout, as he states he used under the head stated by him, would discharge five hundred cubic feet of water per minute.

From these data we can calculate the exact path of the water from the time it leaves the spout until it is entirely discharged from the wheel. This path of the water is represented in this illustration with absolute correctness by the blue lines. (p. 147, Ans. 127; also, p. 182, Ans. 22; p. 188, Ans. 49; p. 198, Ans. 11.) The 1841 and 1850 wheels operate exactly the same way. All three discharge all the water at the same edge of the bucket on which it is received, to wit: *outwardly and from the periphery*, and *not inwardly* or *downwardly*.

If turbines act or operate as and by what Mr. Renwick calls reaction, how is it possible for this wheel to so act? The spout cannot discharge water enough to fill any bucket; of course, if this space is not filled it cannot act by what he calls reaction; and, of course, cannot be like Swain's, from his own reasoning.

There is no successive lamina action of the water in Stowe's wheel; and, consequently, one of the prime properties of *the turbine* is wanting. There are no guides. The water acts by

impact alone, and not by continuous pressure, until its power is utilized. Almost as soon as it strikes the bucket, its velocity is such, that it passes off at the periphery with nearly the same momentum which it had on striking the bucket; while in the turbine, its momentum is nearly or quite overcome when it leaves the discharge edge of the bucket.

It could not operate submerged in the water of the lower level; while complainant's and respondent's operate to best advantage when submerged.

Stowe states his 1837 wheel utilized 25 to 30 horse power, (p. 60, Ans. 288); that his 1841 wheel utilized 5 to 6 horse power, (Ans. 289), and that his 1850 wheel utilized 5 to 6 horse power.

Now the entire or gross power of the water which could discharge from the spout used by him with his 1837 wheel was $11\frac{1}{3}$ horse power; that for his 1841 wheel $3\frac{9}{10}$, and from his 1850 wheel $4\frac{1}{2}$ horse power. (p. 204, Ans. 52, 53, 54.)

Those wheels were simply "spoon" or "spout wheels." (p. 136, Ans. 55; p. 198, Ans. 11; p. 182, Ans. 22.)

They utilize only from 15 to 33 per cent. of the power of the water used, which would make for his 1837 wheel, from 2 to 4 horse power; for his 1841 wheel, from $\frac{4}{6}$ to $1\frac{1}{3}$ horse power, and for his 1850 wheel, from $\frac{4}{6}$ to $1\frac{1}{2}$ horse power; while Swain's turbine, under same conditions, for 7-foot wheel would utilize 303 horse power; for 2-foot wheel $20\frac{1}{2}$, under eleven feet head, and $17\frac{1}{2}$ horse power under ten feet head. (p. 152, Ans. 141, 142, 143.)

Stowe also testifies that he made *for his own use* and *recommended to others* the Howd turbine (centre-vent only) instead of his alleged superior wheel during the seventeen years after he made his first wheel. (p. 69, Ans. 404 and 405.)

"When a man is engaged in the department of production where a certain improvement is most important, with the means in his

hands to employ it, if he knew how, and for years manufactures in a different mode, with less accuracy and at greater expense, *this is conclusive that he did not possess the idea.*"

Root v. *Hyndman*, 6 Fish. 439.
Potter v. *Wilson*, 2 Fish. 107.

It is unnecessary to refer to any more of the inconsistencies and absurdities of Stowe's testimony.

Instead of inventing and making a new wheel in 1837, he merely repaired an old "tub" wheel, not moving the shaft from its place, using the same arms, but instead of having floats with plane surfaces, he scooped them out with an adze. This did not change the character of the wheel, nor increase its efficiency; and the wheels of 1841 and 1850 were of the same kind. (p. 58, Cross-Ints. 266–268.)

The testimony of Small, Weeden and Dodge does not strengthen the defence.

Small is a carpenter and joiner. (p. 79, Int. 1.) He never was engaged in making water wheels. He worked a few days in the fall of 1849 on the Spear mill, and about a day in the spring of 1850 assisting in putting in the gig wheel. (p. 80.) He says he was in the shop a number of times, and saw Stowe working on the wheel. The buckets were "shoe-shape," by which he means "hollowed out and turned forward." (p. 81, Ints. 21, 22.) He could not state whether the inner or outer edge of the bucket was the farthest forward until he was shown Exhibit 3, and was made to see what answer was desired; and then he swore that with an unimportant change in the position of the arms the wheel of 1850 was identical with that exhibit, and that the water discharged "in and downwards." (p. 81.) It appears from the rest of his testimony that he had no opportunity for seeing or knowing in what direction the water was discharged. On another and recent occasion he had testified very differently from his present testimony. He had heard the testimony

of Stowe, and had been in the company of Stowe and Ladd so much that he was ready to adopt their opinions and statements as his own recollection.

Weeden is a farmer. He never saw the wheel in operation but once, and did not then examine it very particularly. He was present and heard Stowe's testimony, and from his intimacy with Stowe and Ladd, and from the absence of all motive and reason for his noticing and remembering the dimensions of the wheel and the form of the buckets, and considering also the difficulty, not to say the impossibility, of his remembering the dimensions he pretends, reliance cannot be placed upon the accuracy of this witness.

Dodge pretends to be a mechanic; but upon reading his testimony, especially pages 114–120, his ignorance and untruthfulness will be so apparent that his testimony can have no weight whatever.

But were it to be conceded that the models, Exhibits 2, 3 and 7, introduced by Stowe, correctly represent, and that he correctly describes the construction of the wheels of 1837, 1841 and 1850, the validity of the Swain patent would not thereby be impaired; for the wheel so made has no useful capacity for the performance of the function of the patented Swain turbine; it stops far short of that function. The mechanical means used and the result produced are different. This must be apparent to the Court; and so it will be held not to anticipate the Swain invention. It immediately went out of use, no other such wheel ever having been made. It is thus demonstrated that the alteration in the buckets of this wheel which Stowe made, and which is the only novelty contained in it, had no practical utility.

Waterbury Brass Co. v. *Miller*, 5 Fish. 48.
Sayles v. *Chicago & N. W. R. R. Co.*, 4 Fish. 584.
Buerk v. *Valentine*, 5 Fish. 366.

Union Nickel Co. v. *Auther*, 5 Fish. 517.
Ely v. *Monson & Brimfield Mfg. Co.*, 4 Fish. 64.
Hayden v. *Suffolk Mfg. Co.*, 4 Fish. 87.
Wood v. *Cleveland Rolling Mill Co.*, 4 Fish. 550.
Hawes v. *Antisdel*, 8 Off. Gaz. 685; and cases there cited.
Gear v. *Grosvenor*, 6 Off. Gaz. 316.

These wheels of Stowe's were set and propelled in the same way. They were common impulse wheels. They had no casing at all, nor anything to answer the purpose of casing; no contiguous series of guides, which are indispensable to all turbines. They had no inward or downward discharge of the water, such as is so called in the Swain reissue, because the water escapes from such wheels substantially in a tangential direction outside of the wheel, and only the scattering water, if any, passes inward or downward. (Hibbard's ev., p. 182, Int. 22; p. 188, Ans. 49.)

They have none of the elements of, nor are in any sense, turbines. They are of that very old class of wheels known and described as spout or spoon wheels, in which the water acts by percussion or impulse alone. All turbines operate as well or better when submerged, whereas the Stowe wheel under like conditions would be useless. (Swain's ev., p. 148.)

This Stowe wheel differs from the Swain wheel in the fact that it is not a turbine at all. It is nothing more than a common tub wheel with the water pitched upon the periphery instead of being pitched in over the floats, as usually practised in the old tub wheel. It has but one spout, covering only about one-twelfth of the periphery of the wheel, instead of covering the whole periphery with spouts or guides, as is done in the Swain contrivance. (Water's ev., pp. 198, 199.)

Mr. Renwick attempts to show a similarity between the Stowe wheel and the Swain wheel, (p. 127, Int. 10; pp. 205, 206, Int. 8), but the attempt is futile. It is just as absurd as to attempt to show that any of the old tub or spoon wheels were turbines.

It is noticeable that, although Stowe was examined at great length, and frequently speaks of the wheels made by him in New Jersey as turbines, and refers to various kinds of turbines seen by him before he went to New Jersey, he nowhere speaks of the wheels made by him in 1837, 1841 and 1850, as turbines.

Stowe's statements as to the power of the wheels made by him in 1837, 1841 and 1850, show his gross ignorance, notwithstanding he is claimed to be an expert, (p. 40, after Int. 30), or his untruthfulness.

He testifies (p. 60) that his 1837 wheel was of twenty-five to thirty horse power, and the 1841 wheel about five or six horse power, and his 1850 wheel six or seven horse power, as they were used.

Whereas, the gross power of all the water which could pass through such openings would be for the 1837 wheel eleven and one-third horse power only, for the 1841 wheel three and nine-tenths horse power, and for the 1850 wheel four and one-half horse power only (p. 136); and the *net* power by use of these wheels would not exceed twenty-five per cent. of the gross power. His testimony respecting dimensions and proportions is as absurdly false and conflicting throughout.

The power of the water used by Swain's wheel of same size as Stowe's 1837 wheel would be 303 horse power; that used by Swain's wheel of same size as Stowe's 1841 wheel would be twenty and one-half horse power; and that used by Swain's wheel of same size as Stowe's 1850 wheel would be seventeen and one-half horse power. (p. 152.)

INFRINGEMENT.

The defendant in his answer denies that he made, used or sold water wheels embodying the Swain patented invention and improvements, or any material parts thereof. (p. 16.)

The connection between the question of infringement and the validity of the reissue, and the construction to be given to the reissue, is so intimate, and, in view of the opinion of SHEPLEY, J., in this suit, so important, that under this head of infringement, I shall make some additional suggestions relating to the reissue, and in aid of the suggestions shall give illustrations of some of the wheels referred to in the evidence.

Fig. 1, (page 42*a*), represents a vertical section of the wheel part of the Boott centre-vent turbine (reduced by scale), as constructed by Mr. Francis, in 1844, and which furnished power in said Boott mills until supplanted by a Swain turbine in 1875. The Swain turbine being placed in the same pit, and for same diameter utilizing 73% more power. (pp. 138–141, 161, 162.)

Both the centre-vent turbine and the Swain turbine were tested by Mr. Francis, at great expense, in the same pit; and for same diameter of wheel, for every twenty-seven horse power utilized by the centre-vent turbine, the Swain turbine utilized one hundred horse power.

The percentage of useful effect, regularity and degree of speed, part gate results, and many other features of merit, were far in excess of the centre-vent turbine. In the upper part of Swain's turbine are embodied the valuable properties of the centre-vent turbine. (pp. 147, 148 and 296; also, Waters, p. 190, Ans. 8.)

Fig. 2 represents the wheel part of a Jonval turbine designed and built in accordance with Nystrum's rules, of same diameter as the Boott centre-vent turbine. (See Complainant's Exhibit "H.") All the valuable properties due to this turbine, are embodied in the lower part of Swain's turbine. (p. 147, and Waters, p. 190, Ans. 8.)

Fig. 3 represents the wheel part of a Swain turbine of ordinary construction under the reissued patent, of same capacity, about one-half the diameter only, and possessing all the valuable properties of the other two turbines.

Fig. 1, on (page 44*a*,) represents a vertical section through the centre of the wheel part of the "Howd" or "United States" turbine, a centre-vent turbine, patented July 26, 1838. (p. 143, Ans. 97.)

Complainant's patented turbine embodies in its upper portion all the valuable features of this turbine. (p. 147, Ans. 127; p. 190, Ans. 8; p. 185, Ans. 32; p. 177, Ans. 5 and 7; p. 181, Ans. 21.) It has an upper horizontal crown, and was well known prior to Swain's invention. (p. 143, Ans. 97.)

This crown was a well known equivalent for curved or inclined crowns for centre-vent turbines, prior to Swain's invention, (p. 143 Ans. 99); and all were substantially the same. (p. 143, Ans. 98; p. 179, Ans. 13; p. 185, Ans. 31; p. 187, Ans. 39.) Stowe says he *first saw and heard of the centre-vent turbine* in 1845. (p. 47, Ans. 118.)

(*Eight years after he claims to have combined it with the Jonval turbine to obtain the united power of both in one turbine.*)

Thereafter, he not only recommends it to others, and makes it for others, (p. 69, Ans. 404; p. 70, Ans. 405), but he *actually constructs two for his own use*, at greater expense, with less advantage to himself, in preference to using the one he claims to have invented, and which he claims was of greater capacity and less cost. (p. 60, Ans. 404; p. 118; Ans. 132, 133, 134.)

Fig. 2 shows a vertical section through the centre of the wheel part of a Jonval turbine of the Burnham type. (p. 143, Ans. 100.)

Complainant's patented turbine embodies in its lower portion all the valuable features or properties due to this type of Jonval turbine. (p. 147, Ans. 127; p. 190, Ans. 8; p. 185, Ans. 32; p. 177, Ans. 5 to 7; p. 181, Ans. 21.)

Fig. 3 shows same part of the same turbine with lower inner edge of the bucket and inner band cut away, substantially same as the "Hartshorn" "Whitney" turbine, Complainant's Exhibit T.

This cutting away doesn't change the character or type of the wheel; it remains substantially the same Jonval turbine in character, operation and effect. (pp. 146, 149; p. 181, Ans. 19; p. 196, Ans. 10.)

Fig. 4 shows the same part of same turbine cut away towards the periphery instead of towards the centre, and with same results only.

Fig. 5 shows the angle of the upper part of the bucket of this turbine, same as in Whitney's "Hartshorn" turbine, Exhibit T.

Fig. 6 shows development of the periphery of its crown, band and buckets, by which is seen the vertical line of the upper part of the bucket and the Jonval curve to the lower part of the bucket, same as is seen in Complainant's Exhibits, T, H, D, and in all exhibits of complainant's patented turbine.

Respondent claims that by the curving of the crown of complainant's patented turbine, it has no centre-vent turbine property to the upper part of it; that in order to have a combination of the properties of the two wheels in one, the upper crown must be horizontal. That as the respondent's crown is horizontal it is no infringement.

The proofs show that for centre-vent turbines, horizontal crowns, like respondent's crowns, dropping in a straight line as they approached the centre of the wheel so as to be much lower at

their inner edge than at their periphery, crowns dropping as the above, but having a curved, concave surface like complainant's, and crowns of various other shapes, *had been used and were well known equivalents, one for the other, for years prior to Swain's patent, and long prior to his invention of his turbine. That many of them were well known to him, prior to his invention, as equivalents, one for another.* (See Ans. 95, 96, 97, 98 and 99, pp. 142, 143.) It also is proved that they were not only well known as such to Swain and others prior to his invention, but that he had personally used horizontal crowns, and crowns curved variously, in the construction of his turbines prior to his patent. (See Exhibits L, M, N, R, I, W and S.) It is also proved that these differences in shape of crown make no difference, whatever, in the character, principle or operation of the turbine; they are all the same as respects Swain's invention and patent. *They are not of the essence of the invention; they are merely structural differences, effecting unimportant degrees only, having no relation to principle or character of the invention.* (Ans. 95, 96, 97, p. 214; 98 and 99, pp. 142, 143; p. 179, Ans. 12, 13, 14; p. 185, Ans. 31; p. 199, Ans. 12.)

Hamilton v. *Ives*, 6 Fisher, 244.
Decher v. *Grote*, 6 Fisher, 143.
Smith v. *Fay*, 6 Fisher, 450.

Fig. 1, (on page 46*a*,) shows the shape of the crown of the Blake centre-vent turbine, extensively made and used long prior to Swain's invention. (pp. 142, 143, Ans. 95, 96, 97, 98, 99, and p. 165, Ans. 284.)

Fig. 2 shows the shape of the crown of the Warren centre-vent turbine, also extensively made and used long prior to Swain's invention. (See p. 143, Ans. 97, 98 and 99). The Howd centre-vent turbine, patented in 1838, had horizontal crown, and was same as Warren's. (See illustration of Howd turbine, on page 44*a*, *ante*.)

Fig. 3 shows the shape of the crown of the Boyden centre-vent turbine, patented in 1853, and made extensively, prior to Swain's

invention, with crowns shown in this illustration, also with crowns having convex surfaces next to the water, and with various other shaped crowns. (p. 143, Ans. 97, 98, 99.)

Fig. 4 shows the crown of a Boyden centre-vent turbine, built for Silver & Gay, about 1844, and used ever since. (p. 143, Ans. 97, 98, 99.)

See, also, shape of crown of Leffel's turbine, on page 54*a*, *post*, which Mr. Renwick says is a perfect combination of the centre-vent and Jonval turbines. (p. 123, Ans. 3.) The Patent Office model drawings show nearly as great a curve of crown as is found in complainant's patent and model; and all the wheels made by Leffel, and all illustrations by Leffel of his wheel, show a crown over the buckets of the centre-vent part of his wheel, with more curve and depression than was ever made for practical use in any wheels under complainant's patent.

Hanna's centre-vent turbine referred to by respondent in his answer (but which he failed to refer to in evidence), made in 1859, and prior, had crown and coupling substantially like Swain's.

The centre-vent turbine of Tiller and Dillingback, made in 1848, had its crown substantially like Swain's.

That of a large number of infringers, who, after notice, discontinued further infringement, some taking licenses from complainant, acknowledging the validity of said reissued patent and paying royalty, several of their infringing wheels had horizontal crowns, like respondent's. (p. 146, Ans. 120.)

Fig. 1, (on page 47*a*,) illustrates *the horizontal shape of the crown*, and the central and downward discharge edges, or line of the bucket of the six-inch turbine, made by Mr. Swain, in 1856–7, and completed and used in 1858. (p. 132, Ans. 20.)

Fig. 2 shows a development of the crown and buckets; no band was used on this wheel. We find the Jonval curve to the lower

part of the buckets shown in this figure as it was originally made by Mr. Swain. (Ans. 12, 13, 14, 15, on pages 131, 132.)

Fig. 3 shows the curve to the upper, or centre-vent part of the bucket, by the heavy dotted lines; also, the guides to direct the water on to the buckets.

It is apparent, upon a cursory inspection, that this turbine is substantially the same in every respect as that described, shown, and claimed in said reissued patent, No. 5154.

It is also proved to be substantially the same, in every respect, by witnesses. (Waters, p. 199, Ans. 12 and 13; Hibbard, p. 179, Ans. 12; Swain, p. 142, Ans. 95, *et seq.*)

It is not controverted by respondents by any testimony. It is drawn to a scale from the original turbine, Complainant's Exhibit I. It is substantially same as is shown by the drawings made by Swain, in 1856 and 1857, and sent to John Lovett, in March, 1858, and explained fully to said Lovett before he went to Minnesota. (p. 169, Ans. 12, 13, 14, 15, 16; pp. 169, 170, Ans. 23, 24, 29; and Clark's deposition, pp. 173, 174.)

On page 48*a* are copies of parts of the drawings sent to Lovett in 1858, and shown to Clark prior to that date. (pp. 132, 133, 168–170, 179, Ans. 12; p. 184, Ans. 26.)

These drawings represent Swain's invention to be substantially the same at the time they were made, as is shown and described in the reissued patent.

Lovett says Swain told him what he had invented before he went to Minnesota, and that it was the same as shown by the reissued patent, and as it had always been made; (pp. 168, 169); and Swain says he described to Lovett what he had invented before Lovett went West, and that Lovett understood it.

These drawings show the curves of the buckets, the discharge

lines, the spaces for the discharged water to pass into and off, guides, crown and band, all substantially the same as is shown and described in said reissued patent. For capacity, character and effect they illustrate a turbine which would embody the same properties, operate in the same way, and produce the same results as said patented turbine does.

They show, conclusively, that Swain had then fully invented his turbine substantially as shown and described in said reissued patent, and that he had no intention of making any such contrivance as Mr. Renwick states Swain made.

The letters, Exhibits J and K, show previous knowledge by Lovett before he went West, in the spring of 1856, of Mr. Swain's invention.

These letters, with the corroborative statements of Mr. Lovett, establish the date of Mr. Swain's invention as early as the fall of 1855, as stated by Swain.

On page 49*a*, is illustrated the "Austin turbine," so called in this case, being the first turbine, of large size, made and operated in a mill by Mr. Swain. It was completed and put in operation in the fall of 1858, (p. 130, Ans. 10;) and has been in use ever since, until it was introduced into this case as Complainant's Exhibit R. (pp. 133, 134, Ans. 32, 33, 34, and Sargent's and Clark's testimony, pp. 170–174.)

It was tested in 1858–9, with highly satisfactory results. (p. 133, Ans. 32.) Its success caused others to at once give Mr. Swain orders for wheels. (p. 130, Ans. 10.)

By comparison of the results of tests of this turbine with all those built by Mr. Swain, or his assignees, and tested, it will be seen this first large turbine proved to be of as great capacity and efficiency as any. (p. 138, Ans. 71.)

It is proved to be substantially the same as first conceived by

Swain, and as always made by him and his assignees, and as described and claimed in said reissued patent.

Waters, p. 199, Ans. 12 and 13.
Hibbard, p. 179, Ans. 12.
Swain, Ans. 72 and 95–106; on pp. 139, 142–144.

All the figures are drawn to a scale from the original, the Exhibit "R."

Fig. 1 shows a vertical section through the centre of the wheel-part of the turbine, showing the curvature of the crown in a radial vertical plane, the coupling or arms, hub and band, also, the discharge edge of the bucket extending from the crown at its upper inner edge around to the band, and the space for the discharged water to enter into and pass off, due to the centre-vent part of the turbine and the Jonval part of the turbine.

Fig. 2 shows a development of the buckets, crown and band. The Jonval part of the bucket is shown, but not so long as in previous and subsequent turbines made by Swain and his assignees, for the reason given by Swain in his two hundred and ninety-seventh answer, on page 166.

The first turbine was made *wholly of cast iron, and in one piece.* It was found impracticable to make them in this way, because the iron would not flow in so thin a sheet to the lower parts of the buckets. It would chill and leave imperfect buckets; so, after three or four unsuccessful attempts, and by shortening up the core-patterns to the lower part of the buckets, this wheel was obtained., (Swain's 297th Answer, on p. 166.)

It will be seen, by reference to the Nesmith wheel, Exhibit S, the buckets are of sheet metal secured to the rest of the wheel in casting; and all wheels made since have been made with sheet metal buckets for this reason. Notwithstanding this shortening up of these buckets, the wheel shows about the same capacity and results; (Ans. 71, p. 138); and is substantially the same turbine in princi-

ple, character, and operation as those described and claimed in said reissued patent; (p. 179, Ans. 12; p. 199, Ans. 12); and substantially same as defendant's infringing turbine. (p. 147, Ans. 127; p. 37, Ans. 5.)

Fig. 3 shows in horizontal p'ane through a section at top of the turbine, the guides, buckets, arms and hub, by which will be seen the curves and angles of these parts of the buckets and guides are same as in any centre-vent turbine, and substantially such as shown in the drawings sent to Lovett by Swain, in March, 1858, Exhibits L, M, N.

The upper figure, (on page 50*a*,) shows a vertical section of the wheel part of the 30-inch wheel constructed by Swain, in 1859, for Mr. Nesmith. (p. 131, Ans. 10.)

The next figure shows a development of the periphery of the crown, buckets, and lower band, in which we see the Jonval curve to the lower part of the buckets.

The lower figure is a horizontal plane, showing the upper edge of the guides, buckets, coupling-plate and hub.

These figures are drawn to a scale, and are accurate representations of the original wheel, Exhibit S, now in this case.

In them we find all the elements and properties substantially as afterwards shown and patented by Swain, and as now shown and claimed in said reissued Letters Patent, No. 5,154. We find here *every property* enumerated in said 1st, 2d, 3d, and 5th clauses of claims. (p. 199, Ans. 12, 13; p. 179, Ans. 12; Swain's Ans. 72–95 and 106, on pages 139–143, 145.)

This 30″ Nesmith wheel, (with several others like it), was constructed by Swain and put into operation in 1859, (Swain, 10th Ans.; also 33 and 34), *prior to obtaining his patent, and with Exhibits I*

and R shows conclusively what he invented and supposed was secured in his first patent. It furnishes a conclusive answer to respondent's statements that the reissued patent is broader than the invention.

It shows conclusively that the language of the original patent "when J is lowered," &c., if construed as respondent claims, was improperly in said patent, and was properly left out of the reissued patent. The proofs show said model was roughly made, more to show the character and principle of the invention, and to meet the call of the Patent Office, than to furnish an exhibit of accurate proportions throughout. (p. 145, Ans. 107.) That such is the case is apparent from an inspection of the model, Exhibit E. Several other wheels of the same size and character were constructed and put into operation prior to the date of his patent, all working same as the wheels he has always made, both prior and subsequent to his patent. (p. 130, Ans. 10.)

The figure, (on page 52*a*,) represents a copy (drawn to exact scale) of the drawing with Swain's original and reissued patent, with the addition of lines on the right-hand side, showing the path of the water, in its lateral course, as it enters the bucket; as it leaves the discharge edge of the bucket; as it passes the horizontal plane, at the lower edge of the band; as it passes down between the coupling and curb, and thence, out between the lower curb and base. (p. 140, Ans. 81, *et seq.;* p. 180, Ans. 17; p. 193, Ans. 8.)

It will be noticed that all the curves of each part of the structure are such as to best aid the flow and discharge of the water before and after its power is utilized in its passage out through the path of least resistance into the water of the lower level. There is clearly shown in this drawing *the height* of the centre-vent part of the bucket, "*equal to that*" of the well-known Fourneyron, or Warren, centre-vent turbines, "*and that due to the width*" of the bucket, in a radial direction, as in the Jonval turbine. (p. 139, Ans. 72, 75, 78; p. 144, Ans. 106; p. 179, Ans. 12; p. 177, Ans. 4, 5, 6, 7; p. 199, Ans. 12; p. 178, Ans. 10; p. 141, Ans. 82–90, inclusive.)

By measurement of the Patent Office model and drawings of the original and reissued Letters Patent of Swain, and comparing these measurements with those of a properly constructed Jonval and centre-vent turbine, it will be found that there is more area for same diameter in Swain's than in the other two combined, for capacity and useful effect, even if such measurements are confined to the exhibits from the Patent Office. (p. 141, Ans. 82 to 88, inclusive.) This is not only apparent upon inspection of the exhibits, but is fully proved. (p. 141, Ans. 87, and prior Ans.; p. 177, Ans. 6; p. 179, Ans. 12; p. 184, Ans. 26; p. 186, Ans. 34.)

The drawing of the original patent, Exhibit W, is exactly the same as the reissued drawings, one being copied exactly from the other. (p. 178, Ans. 10; p. 135, Ans. 42, 43; p. 144, Ans. 106.)

The model (see duplicate, Exhibit E), was not changed when the original patent was surrendered and the reissued patent obtained. (p. 134, Ans. 41, and prior Ans.)

A turbine constructed to have a greater effective capacity or discharge without increasing the diameter of the wheel and simultaneously partaking of the properties of the centre-vent and Jonval turbine, embodies Swain's invention, whatever the degree of perfection in proportion may be.

There is, even in the model, Exhibit E, and shown in the original drawing, Exhibit W, ample room for the water discharged from the upper or centre-vent portion of the wheel to pass into and off under the centre of the wheel, and within the inner edges of the buckets, without occupying any of that area due to the water discharged from the lower, or Jonval portions of the bucket; the water discharged from the lower portion of the buckets, passing into and off through the annular space directly under the bucket, and bounded by the lower edge of the band, and an imaginary cylinder of same diameter as the space within the inner edges of the buckets. (pp. 140, 141, Ans. 81 to 89, inclusive; pp. 185, 186, Ans. 33, 34; p. 190, Ans. 8; p. 199, Ans. 12, 13.)

Fig. 1, on page 54*a*, is an exact copy of the Patent Office drawing of the wheel part of James Leffel's turbine, reduced by scale to same size as Fig. 2, the copy of Patent Office drawing of wheel part of Swain's turbine.

For certified copy from Patent Office of Leffel's drawing, see Complainant's Exhibit "V," and for certified copy of Swain's Patent Office drawing, see Complainant's Exhibit "W."

On this certified copy of Leffel's drawing, in blue ink, are lines showing the course of the water flowing while within the buckets and while within the area for reception of discharged water, placed on the original by the applicant.

The crown and coupling are nearly as much curved as is shown in Swain's office drawings, and more than is shown in most of Swain's exhibits of wheels made prior and subsequently to his patent.

A red line, showing the discharge edge of the bucket of a Swain wheel, drawn in this Leffel illustration, will show how the water, as represented by Leffel as passing through his wheel, would leave the discharge edge of Swain's bucket; *i. e.*, exactly as it would in Swain's turbine, and as shown and proved by exhibits and testimony of complainant. Red lines, drawn over the Swain illustration, Fig. 2, show how the water in Swain's structure would be distributed within and beyond the Leffel buckets; *i. e.*, substantially as it would in Leffel's structure. The water, acting on the lower part of each, would be the same, whether one lower bucket was used or the other; and that, acting on the upper part of either, would be the same, whether one upper bucket or the other was used and whether in one structure or the other.

In this Leffel turbine we find the same shape, curves and angles of the buckets and crown as in Swain's, the water entering and discharging the same, the same areas or spaces for the discharged water to pass into and off, guides to direct the water to the buckets substantially the same; the only difference being the introduction of a diaphragm, which is proved to rob the turbine of much of its useful effect and capacity. Respondent's witness, Renwick, says in his testimony, that this Leffel turbine is a correct and complete embodiment of the combination of the centre-vent and Jonval turbines in

one turbine. That Swain's turbine combines the properties of these two turbines more effectually, producing better results, is not only apparent upon a cursory inspection of the two, but is proved by the testimony and Exhibits of complainant.

Fig. 2 represents a copy of the Patent Office drawing enlarged to a scale, showing a vertical section of the wheel part of Swain's turbine, drawn same size as the drawing of Leffel's, above, Fig. 1.

By measuring the areas of the two, such areas as are requisite for the diameter of the wheel, it will be found they are exactly the same. This drawing of Swain's, while it fully illustrates the character and principle of Swain's invention, does not represent the best proportions for constructing the turbine to obtain the greatest possible results. The Complainant's Exhibits I, R, S, and all the drawings, represent a more complete and perfect type of turbine, combining the properties of the other two types, than is found in any of Leffel's structures, drawings or illustrations. All comparisons here made are with and between the respective Patent Office drawings in each case. The wheels made by both parties for actual use, upon comparison, will be found to be more nearly alike in every detail than in the drawings.

Figs. 3 and 4 represent the curves to the centre-vent part of Swain's bucket and the Jonval part of his bucket, as shown in his original and reissued drawings, the drawings in both being the same.

Swain's turbine was not referred to in Leffel's Ohio case, and was not considered by Judge Emmons. Leffel's wheel could not be separated and have two perfect wheels. Leffel's was patented about two years subsequently to Swain's, and invented but one year prior to Leffel's patent, as his proofs show. Angel's turbine had crown curved as much or more than Leffel's or Swain's.

Fig. 1, on page 55*a*, represents a vertical section of the wheel part of a Swain turbine, as they have been constructed by Mr. Swain's assignees. (See p. 141, Ans. 87; p. 136, Ans. 51; p. 134, Ans. 47; p. 179, Ans. 12.) The dotted lines, through the right

hand portion of the wheel, show the relative area of space occupied by ten laminæ of water in their lateral course at all points from their entry to the buckets until their final exit from the circle under the wheel within the band.

See testimony of Swain, pp. 140, 141, Ans. 81–88.
" " Hibbard, p. 183, Ans. 17.
" " Waters, Ans. 8, on pp. 190–195.

"About three and a half of such divisions, or a little over thirty-five per cent." of the water, acts on the centre-vent part of this turbine, and is discharged into and passes off through the space due to the centre-vent part of the turbine inside of the inner edges of the buckets, (p. 141, Ans. 82, 83, 84); and the balance acts on and is discharged into and passes off from the Jonval portion of this turbine. (p. 141, Ans. 85, 86, 87.) This showing of these laminæ is that of a vertical plane or section through the centre of the wheel in a radial direction when the wheel is in motion doing its proper work, and is the lateral movement of the water.

In Fig. 2, page 54*a*, will be found an illustration of the Patent Office drawing, filed with the original patent (the same being refiled with the reissued patent without change in any respect), enlarged to a scale so as to be of same size as the above illustration; by comparing the two, it will be found, every feature or property is substantially the same in one as in the other, and substantially the same as in the drawing sent to Lovett in 1858, and the six-inch, first wheel, Exhibit I, also Exhibits R and S.

Fig. 1, on page 56*a*, represents a vertical section through the centre of the wheel part of respondent's turbine; showing the discharge edge of the bucket, extending from the crown at its inner edge around to the band at its outer lower edge, with the space inside the inner edges of the buckets for the discharged water to pass into and off without occupying any of the space due to the water discharged from the lower or Jonval part of the bucket, together with the area under the bucket for the discharged water from the lower part of the bucket to pass into and off without occupying any

of the space due to the water discharged from the centre-vent part of the bucket; all substantially as found in Swain's patented turbine, and as shown and described in said reissued patent.

Fig. 2 shows horizontal plan view of upper part of respondent's bucket, the surfaces of which are not of exact curvature as in complainant's patented turbine, but are substantially the same, performing the same office and having the same properties. They are substantially the same as are found in all centre-vent turbines. (See Exhibits G, E, F, and illustrations of centre-vent turbines.) Respondent's witness, Renwick, says these differences in curve of the bucket make no difference in character of the wheel; they are not material or substantial differences. (p. 201, Ans. 1; p. 204, Ans. 3.)

Fig. 3 shows development of respondent's wheel, by which we trace the Jonval curve to the lower part of the bucket, substantially as is found in all Jonval turbines, and in complainant's patented turbine. (See Exhibits H, E, F, also illustrations of Jonval turbines.) *Respondent admits his wheel is exactly like complainant's patented wheel, and that it is the best wheel known.* (Complainant's Exhibit O, following p. 22 in that exhibit; also Swain's Ans. 63–65, p. 137.) Waters, Hibbard and Swain state fully wherein and why it is like Swain's. (p. 148, Ans. 127; p. 137, Ans. 61 to 66, inclusive; p. 29, Ans. 22 to 27, inclusive; p. 37, Ans. 4 and 5; p. 185, Ans. 30; p. 190, Ans. 5, 8, 10.) Renwick states that if the Court should construe the complainant's reissued patent, as it claims for it, then the respondent's contrivance infringes complainant's patent. (p. 128, Ans. 11.)

Many of the infringers of complainant's patent, who have acknowledged the validity of Swain's patent as reissued and taken licenses under said reissued patent, made their wheels substantially like respondent's in every detail. (p. 146, Ans. 119, 120, 121.)

It is admitted in the agreements (printed on pp. 10 and 17 of the record), that respondent sold turbines substantially the same as shown on page 4 of Exhibit O, and by Exhibit D.

The crown in respondent's wheel is horizontal, or nearly so. *That the shape of the crown is not of the essence of Swain's invention, that no difference exists in the turbine, whether the crown is horizontal or otherwise, and that one crown is an equivalent for the other, and was well known as such to the public prior to Swain's invention, and that all of the different shapes were known to and used by Swain prior to date of his patent, and that many of the infringers who have acknowledged the validity of the reissued patent, and paid royalties under it, used crowns of different forms, is fully shown by the testimony, and is referred to specifically in the suggestions with plates.*

The figure, on page 58*a*, is a copy (reduced to a scale) of the drawing, Exhibit D′, made by Mr. Waters and introduced into this case by him to illustrate his testimony. He commences his testimony relating to this on page 193 of printed record.

The Swain Patent Office drawings represented here are enlarged to a scale.

The same is true as to its representation of the Whitney turbine.

The dotted lines on the right over the bucket, and the space inside and under the bucket, are drawn to show the appearance of the laminæ of water as to the vertical and radial plane of the wheel, and are substantially the same as stated by Swain and Hibbard; and they show the proportion of water acting laterally upon the centre-vent part of the bucket and discharging from that part into the space within the inner edges of the buckets, and under the central part of the wheel, as in any centre-vent turbine, to be the same as stated by Swain and Hibbard; and the balance is shown to act on the part of the bucket similarly to that due to the Jonval turbine, and discharging and passing off substantially the same as in such turbine, as is also stated by Swain and Hibbard.

Mr. Waters testifies that the Swain invention consists in lengthening the discharge aperture by leaving out the inner wall of the Jonval turbine and lower crown of the centre-vent turbine, and so

shaping and arranging the bucket as to utilize the power of the water passing over or through it, and availing of the combined space under the wheel for the discharging water to pass into and off, which is found in those two wheels.

That, as shown by his Exhibit D′, the space occupied by the water discharged from a Jonval wheel would extend only from 6 to *a* on the right of Exhibit D′; and that occupied by the centre-vent part would extend only from 6 to *b;* while Swain's invention utilizes the entire space from *b* to *a*.

He also testifies that while the Whitney turbine occupies this width of space for the water to leave the lower part of the wheel from, the objection to this is, that the buckets occupy the same length, and that the inner portions of these buckets move so much slower than the outer portions, that those portions of the buckets have to force back or into a different course considerable of the water; and, in doing so, much of the power of the water acting on the entire wheel is required to overcome this serious objection. This statement is corroborated by Swain. (p. 137, Ans. 59 and 60; Hibbard, p. 184, Ans. 25.)

Mr. Waters' testimony respecting the Whitney turbine is printed on page 196, answer 10. Neither the Jonval, nor any type of turbine, can properly have the buckets exceed in width or space, radially, more than of the diameter of the wheel part, for the reasons stated on pages 137 and 184; so that while a wheel like Whitney's may have the buckets extend radially to the shaft, all that width beyond the limit referred to will not only prove worthless, but will seriously depreciate the useful effect of all the water used.

Respecting the respondent's turbine, Mr. Waters testifies that the extending of the vertical height of the inner edge of the bucket from *h* to *d* doesn't change the character of the wheel; that it still has the vertical height from *c* to *h*, and the curve from *c* to *x*, substantially same as Swain's, for the same purpose and operating in

the same way, and utilizing the same space as shown on right of said Exhibit D, from *a* to *b*. (See page 58*a*, *ante*.)

That the extending of said vertical line from *h* to *d* is an injury. Whether it is an injury or benefit can be only a question of degree; for every element and property of said Swain's patented turbine remains in said infringing turbine unchanged, whether extended or not. The proportions of the infringing turbine are undoubtedly defective; so much so as to prevent its utilizing the high percentage of useful effect which the complainant's wheel does. This is a variance in degree of proportions only, and not in kind, character, principle or operation, and furnishes no relief for the infringer.

Respondent's witness, Renwick, testifies that he cannot tell whether or not the extending up of this portion of the bucket is an advantage or an injury. (p. 202, Ans. 2.)

Fig. 1, on page 60*a*, represents the wheel part of the Whitney wheel, which is in this case for the respondent under the agreement on page 9 of printed record, and subject only to the *conditions* and *limitations* therein stated.

Fig. 2 represents a vertical section of the wheel part of a Whitney wheel sold and put into the factory at West Chelmsford, by said Whitney, in 1863. (p. 151, Ans. 130 and 131.)

Fig. 3. represents a section of a model used by the respondent in this case at Portland, this same model being introduced into this case by respondent *under objection of complainant*. (p. 124, Ans. 5.)

Respondent at Portland, and in the case here, claimed that said model was *exactly* like the "Hartshorn" Whitney wheel, so called, shown in Fig. 1, and referred to in the agreement on page 9, and this *after the respondent had personally visited Hartshorn's mill and inspected said wheel*. (p. 175, Ans. 10.) *Complainant afterwards produced the original wheel, and introduced it in its case as Exhibit T. It shows exactly what Whitney made.* It also shows the

attempt of the respondent to falsify the facts respecting this wheel. *It shows the effort of the respondent to make this Court believe this Whitney-Hartshorn wheel was like the complainant's patented turbine; whereas it in no respect resembles it.* Respondent notified complainant he should produce Mr. Whitney as a witness; Mr. Whitney was near at hand and easily to be had, yet respondent failed to call him. Both Sargent and Swain testify they were familiar with the wheels Whitney was making and selling up to 1871 (the time Whitney inspected Swain's wheel at the Lowell test), and that *they were all like Exhibit T.*

The operation and effect of this Whitney wheel, as stated by Whitney in his pamphlets, circulars, &c. (see Exhibits "A′," "B′"), are entirely different from Swain's; quite the reverse. It is substantially like the Burnham-Jonval wheel, cut away slightly on inner edges of the bucket, and inner ring, as shown by the illustration of that wheel. It has no centre-vent wheel part to it whatever. There is no evidence that Whitney ever made any wheel like Fig. 3; he never did; and if he had, it would not resemble complainant's wheel, in any respect, in character, operation or effect. Whitney, in the license and agreement executed by him, admits that the wheels he had made subsequently to 1871, being same as shown on his circular in this case, as Complainant's Exhibit "X," were direct infringements of complainant's said patent; he also admits said patent is a good and valid patent. (See copy of said agreement, Complainant's Exhibit "C′".) Complainant's witness, Sargent, who worked for complainant, and after for Whitney, testifies that Whitney's wheel in no respect resembles Swain's; Hibbard, Waters and Swain all point out fully the differences between the Swain and Whitney wheel. (p. 147, Ans. 127; p. 184, Ans. 25; p. 196, Ans. 10.)

This is exactly the same as the well known Dodge turbine made in 1852. (See Exhibit of Dodge wheel.)

This wheel shows that the space under a greater portion of the wheel is occupied by the discharge edge and openings of the buckets; this space so occupied by buckets of the form shown is a great detriment to the effect of the wheel, not only by not obtaining

any favorable results from the more central portion of these buckets and spaces, but by destroying a great part of the useful effect of the water acting on the outer portions of the buckets. (p. 137, Ans. 59 and 60; p. 184, Ans. 25.)

The red lines drawn over right side of Fig. 1 show so conclusively Swain's turbine to be of a different type, as to make all comment unnecessary.

The upper figure on page 62*a* represents a sectional view, the middle figure a development of the periphery, and the lower view a plan of the top of the buckets of a wheel designed (on paper) by the witness, J. H. Sargent, for the said Waldo Whitney, in 1871, (Exhibit Cc), immediately after which time said Whitney commenced making and selling said Swain wheel in infringement of complainant's patent. (See Ans. of Sargent, p. 170 to 172, inclusive. Swain, p. 144, Ans. 101; pp. 149, 150 and 152.)

Sargent had previously worked for Swain and for the Swain Turbine Company, and was employed by Whitney to "work up his wheel." He made for Whitney an exact copy of the Swain wheel drawings. (pp. 171, 172.) Whitney, after the reissue of the Swain patent, acknowledged his infringement by making such wheels, and solicited a license from complainant, which was executed with several mutual covenants, and signed by said Whitney and complainant, and contains an admission by Whitney of the validity of the complainant's reissued patent, and acknowledgment of his infringement of it. (See Exhibit C.[1])

Whitney's infringing turbine is shown by Exhibit X; also, p. 146, Ans. 120, 121, 122; p. 179, Ans. 12; p. 181, Ans. 20. It is not controverted by respondents.

The illustration of the Greenleaf contrivance (page 62*b*), is copied from the Patent Office drawing. Mr. Swain's testimony respecting it will be found on page 149.

That of Mr. Hibbard on page 183.

That of Mr. Waters on pages 195, 196.

There is no evidence that any wheel was ever made under the Greenleaf patent.

Whether one made in accordance with this patent would work, is wholly speculative. Judging from all the data furnished by the patent, it is very doubtful if it would be operative for any practical purpose. By no possibility could it operate like any turbine, nor has it the properties of a turbine.

A mere cursory inspection of the model or drawings will satisfy any one that in no particular does it resemble complainant's patented turbine. In mechanical construction and arrangement of its details, and as an entirety, it is unlike Swain's invention.

The speculative testimony of Mr. Renwick, that if certain changes or alterations were made in the Greenleaf contrivance it would resemble Swain's, is not admissible, even if such suggestions possessed any merit. To make a structure having any resemblance to Swain's turbine from the material found in the Greenleaf contrivance would be impossible. The Greenleaf contrivance could not operate submerged as a turbine does, nor could the necessary attachments be made to take off its power, if submerged.

The figures on page 63*a* have been prepared to illustrate portions of the testimony referred to below.

Each figure is accurately worked out from the proofs introduced into the case, and shows with accuracy the various properties of complainant's turbine (substantially as testified of by complainant's witnesses, Swain, Waters and Hibbard, pp. 139–142, 177–181, and 191–194); all of which are found substantially the same in defendant's turbine, varying slightly in degree of mechanical construction in defendant's turbine, but operating in the same way, upon the same principle and with the same results.

The properties here illustrated are characteristic of turbines only, and are not found in any of the types of wheels acting by impulse or reaction.

None of these properties are found in the Greenleaf or Stowe wheels.

Fig. 1 shows a development of the periphery of the band and buckets of complainant's patented device, with spaces between lines drawn over the lower or Jonval part of the buckets, showing the different lower outside lamina of water entering the buckets from the guides during their passage through the buckets.

Fig. 2 illustrates several properties of the centre-vent part of complainant's turbine.

(*a*) It shows the curve and angle of the buckets and guides.

(*b*) It shows the different upper lamina of water, entering from between the series of contiguous guides, during their passage through the buckets.

(*c*) It shows the path of one lamina from the time it enters the guides until it is turned to a vertical direction at its intersection, with the vertical portion of the coupling; *i. e.*, while it is within the guides, within the buckets, and within the space between the inner edges of the buckets and the coupling. This path is shown by the numerous fine lines, when the turbine is doing its proper work, and running at its proper velocity. The dotted lines on either side of these fine lines show such path when the wheel is moving at too high or too low a velocity.

(*d*) The three dotted circles inside the inner edges of the buckets show the relative area occupied by the water discharged from the centre-vent portions of the buckets.

Fig. 3 illustrates, by the numerous fine lines, the path of one lower outer lamina of water (say one-tenth of all entering the bucket from between two guides), from its entry to the lower or Jonval part of the bucket until its discharge therefrom, when the turbine is moving with its proper velocity. The dotted lines, each side of these fine lines, show its path when the turbine is moving at too high or too low a velocity.

Fig. 4. In this figure is shown, by the shaded line, the actual angle and length of the path of the upper lamina of water, from the time it enters the bucket until it is discharged from the inner edge of the bucket at 2″, when the turbine is moving at its proper velocity.

The under curved line shows the form of the under surface of the crown and coupling of the complainant's patent turbine, as shown by the Patent Office model and drawings. The bucket extends from the outer vertical line on the left, to the short vertical line drawn from this curved line.

Mr. Renwick is in error in his statement that the water acting on Swain's turbine has any such curve as is shown by the radial vertical section of the crown of complainant's Patent Office drawings or model.

In no instance can any such curve exist, whether confined to the movement of the water through the buckets while the wheel is in motion or at rest.

If the wheel was at rest, the greatest possible curve from a level horizontal line would be no greater than is shown by the middle curved line of Fig. 4; and the length of the path of the water in the bucket would be from the outer vertical line on the left to the second vertical line 2. This curve would not be greater, nor the line longer, relatively, if the wheel was in motion instead of at rest.

The data furnished by complainant's proofs, and here illustrated, are not speculative. The illustrations accord with the proofs obtained, and have been verified by experiments made with great care, at large expense, and many times repeated. In connection with this plate, see plates, pp. 52*a*, 54*a*, 54*b* and 58*a*.

Some, if not all, of the foregoing illustrations would have been inserted in preceding parts of this Brief, if they had been seasonably prepared.

I cannot doubt that the Court will readily conclude that Swain was the original and first inventor of his patented wheel, and that the reissued Letters Patent are valid.

I proceed with the question of infringement, and, as connected with it, the construction to be given to the claims in the reissue.

By the agreements on pages 8 and 17, the defendant admits that in the month of November, 1874, he sold, in Massachusetts, thirty-inch water wheels and forty-inch water wheels, made by the National Water Wheel Company, of Bristol, Conn., from the same pattern as two wheels named in the agreement, and identical with those wheels. One of the two wheels referred to, being a thirty-inch wheel, is put into the case and marked "Exhibit D." (p. 29.)

The stipulation, on page 17, is shown on *that* page to have been made June 23, 1875, and "William Huntley" is the person named as having sold said wheels. But he was really the agent of the defendant, Ladd, and of the National Water Wheel Company; and after his death, at "May Term, 1876," it was agreed that Huntley's name should be regarded as stricken out and Ladd's inserted. (pp. 8 and 9.)

As to this part of the case, the only question is whether the wheel, Exhibit D, embodies the Swain patented inventions, or any material parts of them.

Albert F. Nichols, who is well acquainted with the Swain wheels, and with the patent, testifies, in substance, that the wheel, Exhibit D, has the "same elements and the same construction" as described in the reissued patent, and that it operates in the same manner and produces the same effect. (pp. 29, 30.)

Mr. Hibbard, in his answer to interrogatory 5 (pp. 37 and 38), describes particularly the claims in the reissued patent, numbered 1, 2, 3 and 5, and states that "on comparing Exhibit D with the wheel shown in the reissue, it appears to have each and every property that I have enumerated as characterizing the Swain wheel, as shown in the reissue, differing a little in proportion in some parts, but apparently embodying each and every principle in construction, in this respect, that is described in the specification or shown in the drawing, and apparently for precisely the same purpose; and they are so nearly alike that their substantial similarity is obvious upon cursory inspection."

Mr. Waters, in his answers to interrogatories 5 and 8 (pp. 190–195), describes very fully and in detail the wheel, Exhibit D, in comparing it with the reissued patent, and shows that it embodies the same elements, and in its construction and operation is substantially the same as the wheel described in the reissue.

Mr. Swain, on page 148, describes his patented wheel, which is "a new and distinct type of turbine"; and he also describes the defendant's turbine, shows wherein the two are similar, and states that "the defendant's turbine is substantially the same in principle, construction and operation" as his patented wheel.

The only testimony offered on the other side is that of Mr. Renwick, in his answers to interrogatories 6, 11 and 12, on pages 125–129. If this testimony were directly in conflict with that offered by complainant, it could not control it. *Mr. Renwick never saw any such wheel in operation, and has no practical knowledge of turbines.* (p. 207.)

It is hardly necessary to refer to decisions as to the influence which such expert testimony should have with the Court.

McCormick v. *Talcott*, 20 How. 409.
King v. *Louisville Cement Co.*, 6 Fish. 342.
Page v. *Ferry*, Law's Dig. 318, § 21.
Bell v. *Hill*, Law's Dig. 317, § 14.
Allen v. *Hunter*, 6 McLean, 307.
Brooks v. *Bicknell*, 3 McLean, 447.
Johnson v. *Root*, 1 Fish. 351.
Curtis's Law of Patents, § § 308–310.
Walton v. *Porter*, Webster's Pat. Cas. 584.

But Mr. Renwick substantially admits that the defendant's wheel does infringe the reissue by stating that it would depend upon "how the claims are construed by the Court"; and by stating that if the Court should construe the first three claims, as they doubtless will be construed, "then the defendant's wheel would embody the con-

struction and arrangement of parts referred to in the first three claims." (p. 128.)

Independently of the expert testimony there is other evidence showing conclusively that the defendant's wheel, Exhibit D, is similar to the Swain patented wheel, and that the curvature of the crown hereinbefore referred to is of no importance.

It cannot be doubted that the defendant and the National Water Wheel Company are practically acquainted with the construction and operation of their own water wheels, and also of the patented Swain wheel. Nor can it be doubted that they "and the well-informed manufacturers" named in Swain's answer to interrogatory 119 (p. 146), knew whether there was substantially any difference in the practical working of Swain's turbine by having the crown horizontal instead of its being curved.

The defendant's company issued and circulated a pamphlet, complainant's Exhibit O, and sent one of them to Mr. Swain. A printed circular, which appears between pages 22 and 23 of the pamphlet, was received with it. (p. 137, Ints. 62, 63, 64.) This circular was signed by the defendant and by the officers of the National Water Wheel Company. It contains an erroneous description of the Hartshorn wheel made by Whitney, with affidavits touching a "brass model" which is not now in this case, but was offered at the hearing of the motion for a preliminary injunction, and which does not truly illustrate the Hartshorn wheel.

This circular is dated "December, 1874," and is signed, as before stated, by the "National Water Wheel Co.," by its President and Directors, and by the defendant, "James E. Ladd, Sec. and Treas."

I make the following extracts from it:

"The National Water Wheel Co., of Bristol, Conn., herewith present a statement of facts to their customers and the public, concerning a claim made by the Swain Turbine Co., of Lowell, Mass., for infringement of the Swain patent.

We commenced making turbine water wheels, at Bristol, Conn., some four years since. The wheel made by us is similar to that made by the Swain Turbine Co., and by several other wheel builders; and wheels made on the same principle have been in use about twenty years, and, for this reason, are not patentable. The wheel is made with crown, band, and floats, and has a discharge line on the inner edge of the floats, extending from the crown to their lower outer edge."

I now insert all of the last two pages of the circular, excepting "the accompanying cut of a wheel" [alleged to have been] "made by Waldo Whitney, in 1857."

"THE CLAIMS OF THE SWAIN TURBINE CO.'S PATENT.

Specifications forming part of Letters Patent, No. 28,314, dated May 15, 1860; reissue, No. 5,154, dated November 19th, 1872.

We claim, as the invention of the said Asa M. Swain, the following, to wit:

1. A water wheel, the floats of which have a discharge line extending from the crown at their inner edge to the lower outer edge of the wheel.

2. The combination, in a water wheel, of a crown, band, and floats, having their discharge line extending from the crown at their inner edge to their lower outer edge.

3. The combination, in a water wheel, of a crown and floats, having their discharge line extending from the crown at their inner edge to the lower outer edge.

4. [The fourth claim is omitted, as it has no reference to the wheel.]

5. A water wheel having an effective inward flow and discharge of part of the water, and an effective downward flow and discharge of part of the water simultaneously in one wheel; whereby the effective area of discharge is increased without increasing the diameter of the wheel.

We ask our customers and the public to carefully read the points claimed by the Swain Turbine Co., and at the same time examine the accompanying cut of a wheel made by Waldo Whitney, in 1857. This cut represents a wheel made with a crown, band, and floats, and has a discharge line extending from the crown on the inner edge of the floats to their lower outer edge. It also has an effective inward flow, and discharge of part of the water, and an effective downward flow and discharge of part of the water, simultaneously in one wheel.

The following affidavits show that this wheel was made by Waldo Whitney, previous to the Swain Turbine Company's patent. Besides, we

can produce other wheels, made on the same principle, that have been in use from eighteen to twenty years.

AFFIDAVITS.

I, Waldo Whitney, of Leominster, in the County of Worcester, and State of Massachusetts, being of full age, and duly sworn, depose and say, that I am a manufacturer of water wheels; that in the year eighteen hundred and fifty-seven, I made a water wheel like a brass model this day shown to me by J. E. Ladd, of Bristol, Connecticut, and on which I have marked the letter "W," in two places, and sold said wheel to Jotham Hartshorn, of Amherst, New Hampshire, who afterwards used it for many years; and that I made a large number of water wheels like said model, before the year eighteen hundred and sixty, and sold them to various parties who put them into constant use.

WALDO WHITNEY.

COMMONWEALTH OF MASSACHUSETTS, }
WORCESTER, ss., Nov. 5, 1874. }

There personally appeared the above named Waldo Whitney, and being duly sworn, made and subscribed the above affidavit, before me,

C. H. MERRIAMS,
Justice of the Peace.

I, Martin W. Stratton, of Leominster, in the County of Worcester, and State of Massachusetts, being of full age, and duly sworn, depose and say that I was in the employ of Waldo Whitney, who has made the foregoing affidavit, in the year eighteen hundred and fifty-seven, and know personally that said Whitney made the wheel referred to in his said affidavit; that I assisted in setting the wheel sold to Hartshorn, as therein stated; that said Whitney made other wheels like the one referred to, and sold them before the year eighteen hundred and sixty, which were put into constant use.

MARTIN W. STRATTON.

COMMONWEALTH OF MASSACHUSETTS, }
WORCESTER, ss., November 5, 1874. }

There personally appeared the above named Martin W. Stratton, and being duly sworn, made and subscribed the above affidavit, before me,

C. H. MERRIAMS,
Justice of the Peace.

COUNTY OF HARTFORD, } ss. BRISTOL.
STATE OF CONNECTICUT, }

James E. Ladd, of Bristol, aforesaid, being duly sworn, deposes and says that he is the James E. Ladd referred to in the foregoing affidavit of Waldo Whitney, and that the accompanying cut is a true representation of the model therein named.

JAMES E. LADD.

Signed and sworn to before me, this twenty-first day of December, 1874.

JAMES SHEPARD,
Notary Public.

The facts, as above set forth, are pronounced by some of the best patent lawyers and experts in the country, to be a complete answer to the Swain Turbine Company's claims.

GUARANTEE.

We agree that in case suit for damage for infringement is brought against any one for using our wheel, to take the whole charge, burden, expense, and responsibilities of the suit, employ counsel, and furnish all evidence, and pay all costs that may arise from said suit.

NATIONAL WATER WHEEL CO.,

J. H. SESSIONS, *Pres't.* JAS. E. LADD, *Sec. and Treas.*

J. H. SESSIONS,
N. L. BIRGE,
J. T. PECK,
W. H. NETTLETON,
EDWARD INGRAHAM,
} *Directors.*

Dated at Bristol, Conn., December, 1874."

The wheel made by Whitney in 1857, and referred to in that circular, is "Complainant's Exhibit T"; and the evidence is *conclusive, that it does not resemble the Swain wheel, and that it does not anticipate Swain's patented invention.* (*Ante*, pp. 26–29.)

It will be seen, on inspection of Exhibit D, and of the "cut" on the circular, that the "cut" is a good representation of the Swain patented wheel, and that it does *not* resemble or illustrate the wheel

made by Whitney, in 1857; being the Hartshorn wheel, so-called, complainant's Exhibit T.

The cut and affidavits and statements in that circular, touching the pretence that the Whitney wheel anticipated the Swain patent, are thus shown to be deceptive and untrue.

But the statement, signed by that company, *and by the defendant*, that "THE WHEEL MADE BY US," (Exhibit D being a specimen,) "IS SIMILAR TO THAT MADE BY THE SWAIN TURBINE CO.," is satisfactory, even *conclusive* evidence, that the wheels made and sold by defendant, did infringe the Swain patent.

There is no suggestion in the circular that the wheels made and sold by defendant, were *not* infringing wheels, (if the Swain patent is valid,) but, *an unequivocal assertion that said wheels were similar to the Swain wheel*, and a plain admission that the only defence is that the Swain patent was invalid, because the invention had been anticipated.

It is also claimed in behalf of complainant that the Court, on inspection of the defendant's wheel, Exhibit D, and comparing the same with the Swain patented wheel, as described and illustrated in the specification, drawings and model of the original patent and the reissue, and as shown in the various exhibits in the case, will be satisfied that the defendant's wheel is identical with complainant's patented wheel in character, principle, construction and operation; and that it has all the properties characterizing complainant's wheel, as described and claimed in the reissued patent.

Potter v. *Wilson*, 2 Fish. 102.

The proofs clearly show that Mr. Swain invented a new type of turbine wheel, embracing the elements and properties of an inward or central discharge turbine and a downward discharge turbine, and that the wheel is so constructed as to have additional advantages besides uniting the elements of those two kinds of turbine. Such

wheel is shown and illustrated by the model filed in the Patent Office with the application for the original patent, and is described and illustrated in and by the specification and drawings of the original patent in connection with the model; and the reissue does not contain any new invention, but merely corrects such errors as are within the purview of the Act. The patent and the reissue should be construed liberally, so as to protect the inventor and his assigns in the enjoyment of the invention which was really made and patented by Mr. Swain.

Curtis's Law of Patents, § 310, note 1.
Carew v. *Boston Elastic Fabric Co.*, 5 Fish. 90.
Francis v. *Millor*, 5 Fish. 153.
McComb v. *Brodie*, 5 Fish. 384.
Root v. *Hyndman*, 6 Fish. 439.
Ingells v. *Mast*, 6 Fish. 415.
Jenkins v. *Walker*, 5 Fish. 347.
Hamilton v. *Ives*, 6 Fish. 244.

Mr. Justice SHEPLEY, who heard this suit in the Circuit Court, says (commencing one third from bottom of page 217):

"The reissued patent, No. 28,314, dated November 19, 1872, has its first, second, third and fifth claims so worded as in their broad and literal construction, without any limitation to the invention described in the specifications of the original and the reissued patent, to claim any form of 'water wheel having an effective inward flow and discharge of part of the water, and an effective downward flow and discharge of part of the water simultaneously in one wheel, whereby the effective area of discharge is increased without increasing the diameter of the wheel.' This is the exact language of the fifth claim, which would be void as a claim merely functional, unless this claim be construed, as must also the first, second and third claims, as including the described means of effecting the result. To uphold these claims they must not only be construed in connection with the described means in the reissue, but so construed as not to embrace any invention broader in its scope than the invention described, or substantially suggested or indicated in the original."

I also insert the last paragraph in his opinion, p. 218:

"Giving to these claims the construction which we have indicated, the word crown, in the first three claims, will refer to, and include in the combination, such a crown as is described in the original patent and represented in the drawings of the original and the reissue, and the fifth claim will be limited in its scope to water wheels possessing such elements as we have hereinbefore recited as the described essential component parts of the turbine wheel, described in the specifications and drawings of the original patent. Giving this construction to the claims, the defendant does not infringe, and the bill must be dismissed."

It is respectfully suggested that the learned judge erred in overlooking and ignoring two important facts, each of which has been *clearly proved*, and either of which sustains the complainant's charge of infringement.

(*a*) The description, or claim, in the original patent, that the crown is curved, was inserted by inadvertence and mistake; and to correct such mistakes, reissues are allowed. (*Ante*, pp. 18 and 19.)

(*b*) In turbine wheels, *curved and horizontal crowns are, and prior to Swain's invention were, well-known equivalents.* (*Ante*, pp. 18 and 19.)

Swain's invention is undoubtedly "meritorious and original." His patented wheel unites the advantages of the centre-vent turbine and the downward vent or Jonval turbine. It has "great merit and utility," as Judge SHEPLEY admits. (p. 218.)

It has "*an effective inward flow and discharge of part of the water, and an effective downward flow and discharge of part of the water simultaneously in one wheel, whereby the effective area of discharge is increased without increasing the diameter of the wheel.*"

Prior to Swain's invention, this result had not been accomplished.

In the specification in the original patent, and in the reissue, there is a particular and full description of the patented wheel and of the parts thereof, by which the result, quoted above and set forth in the claim in the reissue, is produced. The crown is described (though erroneously) in the patent as curved. And because the crown of the defendant's wheel is not curved, but is horizontal, or nearly so, it is claimed that there is no infringement.

But, THE USE, OR SUBSTITUTION, OF A WELL-KNOWN AND PROVED EQUIVALENT, AS THE DEFENDANT HAS DONE, does not relieve him from the liability of an infringer.

On inspection, it is apparent that the defendant's wheel (Exhibit D) embodies Swain's patented invention.

Mr. Nichols (on pp. 29, 30), Mr. Hibbard (on pp. 37, 38), Mr. Waters (on pp. 190–195), and Mr. Swain (on p. 148), *all of whom have practical* as well as theoretical knowledge of the subject, testify that Exhibit D does infringe the Swain patented invention.

The National Water Wheel Company and the defendant, in their circular (*ante*, page 69), *assert substantially the same thing.*

Opposed to this, there is only the opinion of Mr. Renwick, who "*never saw any such wheel in operation, and has no practical knowledge of turbines.*" (p. 207.)

JOHN S. ABBOTT.

OFFICE SUPREME COURT, U. S.
FILED
OCT 26 1880
JAMES H. McKENNEY, Clerk

~~No. 550.~~

No. 41.

Supreme Court of the United States.

SWAIN TURBINE AND MANUFACTURING COMPANY,

APPELLANT,

v.

JAMES E. LADD,

APPELLEE.

IN EQUITY.

BRIEF FOR APPELLEE.

By MITCHELL & HUNGERFORD,

Of Counsel.

HARTFORD:
PRESS OF WILEY, WATERMAN & EATON.
1880.

SUPREME COURT OF THE UNITED STATES.

SWAIN TURBINE & MANUFACTURING COMPANY,
APPELLANT,

v.

JAMES E. LADD.

BRIEF FOR APPELLEE.

This bill is based upon letters-patent for certain alleged improvements in water-wheels, originally issued under date of May 15, 1860, No. 28,314, and reissued November 19, 1872, No. 5,154, and extended for the period of seven years from the expiration of the original patent.

The complainant below is the Swain Turbine & Manufacturing Company, and the defendant below is James E. Ladd; the proceedings in two pending suits having been united in one, by stipulation, as appears of record.

The answer, in setting up the defense, relies upon,—

(1). Non-infringement.

(2). The invalidity of the reissued letters patent on account of—

(A) Departure from the original invention.
(B) The functional character of the fifth claim.
(C) Prior use.

(3). Abandonment.
(4). Want of title in present complainant.

The wheel of defendant is shown in vertical section passing through its axis, in figure 1 following, and, in horizontal section passing just underneath the crown, in figure 2.

It will be seen, upon inspection of these figures, that the under surface of the crown is horizontal between the outer and inner limits of the floats; that the discharge lines of the floats are at right angles to the crown throughout nearly their whole length, terminating, however (after sweeping about sixty degrees of a circle), in a band; that the whole under side of the wheel, less a shaft of minimum size, is open for the discharge of water; that the height of the wheel is nearly one half of the diameter of the wheel, thus permitting induction ports of the requisite capacity to supply as much water to the wheel as can escape from its whole under side. It will be seen in figure 2 that the horizontal curvature of each float above the bands is in a *cyma-reversa* or ogee form.

By this construction is produced one form of what is known as the compound or double wheel; that is, a wheel which, by reason of the horizontality of the under surface of the crown and the opening up of the entire interior of the wheel for the discharge of water, and the elongation of the floats so as to admit a sufficiency of water to supply such discharge, and the suitable shaping of the floats so as to eject the water both inward and downward, vents nearly or quite twice as much water in proportion to the diameter of the wheel as either a central discharge wheel or a downward discharge wheel, while at the same time extracting nearly or quite as great a percentage of power from a given amount of water as either those forms of wheels.

I.

The wheel of defendant does not infringe the reissued patent.

What was Swain's actual invention?

Here it will be assumed, for the purpose of argument, that the specification and claims of the reissue will admit of a construc-

tion in subordination to the actual invention as shown in the original specification, drawings and model.

The claims alleged to be infringed are as follows: —

1. A water-wheel the floats of which have a discharge line extending from the crown at their inner edge to the lower outer edge.

2. The combination in a water-wheel of a crown, band and floats, having their discharge line extending from the crown at their inner edge to their lower outer edge.

3. The combination in a water-wheel of a crown and floats, having their discharge line extending from the crown at their inner edge to the lower outer edge.

5. A water-wheel having an effective inward flow and discharge of part of the water, and an effective downward flow and discharge of part of the water, simultaneously in one wheel, whereby the effective area of discharge is increased without increasing the diameter of the wheel.

It will of course be admitted that the defendant is within such a reading of these claims as ignores all reference to the descriptive part of the specification, and all reference to whatever is characteristic in the construction and mode of operation of the structure shown in the original patent, and all reference to the previous state of the art as it appears in testimony, but—

> "To uphold these claims they must not only be construed in connection with the described means in the reissue, but so construed as not to embrace any invention broader in its scope than the invention described or substantially suggested or indicated in the original."
>
> Judge Shepley's opinion, Rec. p. 217.

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By this construction is produced one form of what is known as the compound or double wheel; that is, a wheel which, by reason of the horizontality of the under surface of the crown and the opening up of the entire interior of the wheel for the discharge of water, and the elongation of the floats so as to admit a sufficiency of water to supply such discharge, and the suitable shaping of the floats so as to eject the water both inward and downward, vents nearly or quite twice as much water in proportion to the diameter of the wheel as either a central discharge wheel or a downward discharge wheel, while at the same time extracting nearly or quite as great a percentage of power from a given amount of water as either those forms of wheels.

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> "To uphold these claims they must not only be construed in connection with the described means in the reissue, but so construed as not to embrace any invention broader in its scope than the invention described or substantially suggested or indicated in the original."

Judge Shepley's opinion, Rec. p. 217.

So construed defendant does not infringe. Thus Mr. H. B. Renwick, defendant's expert testifies (Int. 11, p. 128) italics our own :

SEPT. 8, 1875.

"*Int.* 11. Will you now state whether you find the structure Exhibit D (being the alleged infringing wheel of the defendant) to embody the construction and arrangement of parts recited or referred to in either of the claims of the reissue patent in suit, and which, if either, giving your reasons for your opinion?

[Objected to on the same grounds as Ints. 3 and 6.]

Ans. That will depend upon the question how the claims are construed by the Court. If the Court should construe the first three claims to be to a combination of a crown and floats and band, or one of the claims to a combination of the crown and floats alone in all cases, irrespective of the form of the crown and of the floats, and the parts being so combined that the upper parts of the floats shall be attached to and supported by the crown, and the lower outer edges of the floats be attached to and supported by the band, then the defendant's wheel would embody the construction and arrangement of parts referred to in the first three claims; *but if, on the contrary, the Court should construe these claims to be for the combination of these parts when the crown descends, as it extends inwards, so as to force the water downwards rapidly on the bottoms of the floats, and when the buckets are of the paraboloidal shape, described in the original patent, the two being combined in such manner as to discharge the water diagonally, as before described by me, then, under such a construction of the first three claims, the defendant's wheel would not embody the construction referred to therein.* With regard to the fourth, sixth, seventh, eighth, ninth, tenth and eleventh claims, I would state that it is evident that the defendant's wheel does not contain the constructions referred to therein. I have already said that I cannot find, even in the reissue, a description of the mode of constructing buckets so as to produce a wheel having simultaneously

> an effective inward and an effective downward flow, thus increasing the area of discharge without increasing the diameter of the wheel. If the Court should construe this claim [the fifth] to cover a wheel of any shape of bucket which would produce the effects recited in the claim when the space within the wheel was not choked up, then the defendant's wheel would embody the construction referred to in that claim; *but if, on the contrary, the Court should construe that claim to cover a wheel made with buckets substantially such as are described in the original patent and shown in the drawings of both the original and reissue, and operating to discharge water as buckets of that shape would operate, then the defendant's wheel would not embody the construction referred to in the fifth claim of the reissue.*"

Now we submit that the construction assumed by the learned expert, and indicated above by italics, is the true one, and that therefore the conclusion of non-infringement is sound and reliable. That the curved crown to force the water down on the bottom of the floats (which the defendant does not have) and the paraboloidal floats (which are absent in defendant's structure), are both material and functional, appears

(A) From an inspection of the original models and drawings.
(B) From the accurately descriptive language of the original patent.
(C) From the state of the prior art.

(A) *From an inspection of the original models and drawings.*

An examination of the drawings appended to the original letters-patent "Exhibit A" (p. 18), and of "Exhibit E," introduced by complaint as a duplicate of the model originally filed in the Patent Office (see figures 3 and 4 following), clearly shows that the crown is not horizontal within the limits of the floats, but, on the other hand, curves downward as it extends from the periphery inward, merging into a *large conical core* which fills the interior of the wheel, and descends a considerable

distance below the plane of its under side; that no portion of the discharge lines of the several floats is at right angles to the crown; but that, on the other hand, the discharge line is formed, in the language of Mr. Waters (Record, p. 192), "by swinging the delivery orifices in a *curve* from the lower part of the buckets, at the lower rim of 'Exhibit G,' around to the crown of the wheel, so that the water is discharged from the delivering orifices in a long *curved* sheet, from the bottom of the buckets at the periphery of the wheel to the top of the buckets at the crown of the wheel;" that the height of the float is (and is described in the original patent as being) about "three sixths" of the radius of the wheel, a ratio too small to permit of induction ports sufficiently high above the band to admit enough water for the compound or double wheel; that the *curves* of crown and float, as seen in vertical cross-section, substantially meet each other, so that the water forced down by the one will act upon the "lower curved parts or bottom" of the other; that the curves of the floats in horizontal cross section are of a paraboloidal form, instead of having the *cyma reversa* or ogee form of the defendant's floats.

It is evident that we have here the crown and the floats of a water-wheel made in *a certain form*, and put together and into the wheel under *a certain arrangement or mode of combination*, and that such form and arrangement of parts present very marked characteristics relating to the performance and peculiar functions of the parts.

> "In all wheels of this class, form is material, substantial and functional, and very slight changes of form and proportion involve functional changes of great importance."
>
> Judge Shepley's opinion, Rec., p. 215.

Especially is this true of the Swain wheel. Thus Mr. H. B. Renwick (italics being our own):

> "Now the turbine wheel, described in the original patent to Swain, does not discharge the water in either

of these ways [inward or downward]; but, *owing to the shape of the float, and the shape of the crown and hub*, discharges the water in diagonal curved lines leading inwards and downwards; and that it does so, and was intended to do so, appears from the description and drawings of the crown and hub, and the description of the buckets, and from the description of the mode of operation in the patent, which is as follows: 'The water strikes the floats with all the force and velocity due to its head directly under the rim of the wheel, *which is so curved* as to force the water down rapidly on the lower curved parts or bottoms of the floats.' And, also, 'The water is discharged down between the curb and wheel, and lower curb, H.' If there had been any intention of discharging the water in nearly horizontal lines, the lower side of the rim or crown would not have been *bent downwards so as to force the water down*, and the space in the center of the wheel, into which, horizontally, flowing water would escape, and which would be necessary for its escape, *would not have been stopped up by the hub, and the downward prolongation of the crown after it extends inwards beyond the inner edges of the buckets.* And, if it had been intended that any considerable portion of the discharge should have been downwards, as in the Jouval wheel, then the delivery edges of the buckets would *not have been curved*, as I have before described, but would have been formed, as they might be formed, by taking one of the buckets out of Exhibit G and placing it on top of one of the buckets of Exhibit H, the dome of Exhibit H being cut away so as to allow of a discharge from the buckets of G, placed on top of the buckets of H." (Renwick Dep., p. 122.)

(*B*) *From the accurately descriptive language of the original patent.*

The following quotations from the specification of the original patent show that form is material and functional:

"The face sides of the floats '*d*,' where the water impinges, are of *paraboloidal* form whose axes are tan-

gent to a circle, to which the guides '*e*,' hereinafter described, are also tangents, and also to the curve at or near the outer circumference of the wheel" (p. 19).

Again, the following:

"The floats '*d*' may occupy one-third the radius of the wheel and have a depth of *three-sixths* of the same; the width of space occupied by the guides '*e*' may be the same as the floats. The sum of the shortest distance between the guides may be nine-fifths the diameter of this wheel. This, together with the number of guides, determines the narrowest section of each guide, and also the angle at which the water strikes the floats, and also determines, in a measure, the paraboloidal curves of the floats" (pp. 19, 20).

Again, the following:

"When J [the cylindrical gate] is lowered, the water strikes the floats with all the force and velocity due to its head, directly under the rim of the wheel, *which is so curved* as to force the water down rapidly on the lower *curved* parts or bottoms of the floats, the water not leaving the wheel until its force has been properly expended on it. The water is discharged down between the curb and wheel and lower curb H, and is turned outward by the base '*c*'" (p. 20).

These extracts make it clear that the essential elements of the wheel, apart from the means of raising and lowering it, and the means of supplying water to it, are

1. Floats whose face sides where the water impinges are paraboloidal in form, whose upper edges are inclined to conform to a conical crown, whose discharge lines run in a constant curve from the crown downward and outward, discharging the water neither downward nor inward, but in diagonally curved lines.

2. A crown or rim "which is so curved as to force the water down rapidly on the lower curved parts or bottoms of the floats." This curvature is not described as a preferable, but as a characteristic construction, *essential to the proper action of the water on the floats.*

Mr. Renwick says:

> "If there had been any intention of discharging the water in nearly horizontal lines, the lower side of the rim or crown would not have been bent downward so as to force the water down, and the space in the centre of the wheel, into which horizontally flowing water would escape, and *which would be necessary for its escape*, would not have been stopped up by the hub and the downward prolongation of the crown after it extends inwards beyond the inner edges of the buckets. And if it had been intended that any considerable portion of the discharge should have been downwards, as in the Jouval wheel, then the delivery edges of the buckets would not have been curved as before described." (Renwick, p. 122).

Again says Mr. Renwick, alluding to the extravagant claims upon which the plaintiff based his conclusion of infringement:

> "If the wheel had been formed in order to combine an inward flow turbine and a downward flow turbine effectively in one wheel, the crown of the wheel would have been horizontal on its under side, or nearly so; that part of the crown within the inner edges of the bucket and the hub would have been dispensed with, so as to permit free escape of water towards the centre of the wheel and without downward deflection, and the shape of the discharge edges of the buckets would have been altered in the manner before pointed out, and, if the engineer had known how to produce the best effect, the lower inner edges of those buckets of altered shape would have been closed up by a solid ring, so as to force a portion of the water directly downward in the manner in which it is so

forced by the solid ring which shuts up the inner edges of the buckets in Exhibit H" (p. 123).

In this connection it is important to note the following language of the reissue:

> "By this arrangement the water is, *at part-gate*, as well as *at full*-gate, conducted upon the *upper portion* of the floats of the wheel, where it acts with the greatest efficiency, obviating almost wholly the objections incident to other turbines at part gate." (Rec., p. 21.)

This passage is of great significance, and affords a reliable clue to the determination of the question whether the downward curvature of the crown was, in fact and intent, a material part of Swain's invention. It was *because* Swain had matured a valuable method of securing effective part-gate results, and *because* this method consisted in opening from the top downwards a cylindrical gate surrounding the wheel, and because opening the gate from the top downward, caused the entering water to impinge upon the extreme upper limit of the float in any event, and from that point downward according to the degree of opening, that he (Swain) adopted the wheel as described in the original patent, precisely as *so* described, including shape of crown and relative height of bucket and paraboloidal curve. For it is evident that unless the crown was curved downward so as "to force the water down rapidly on the lower curved parts or bottoms of the floats," the thin sheet of water impinging at part-gate upon the upper part of the float just underneath the rim, would fail to "properly expend its force upon the wheel."

If water should so enter under a horizontal crown having no downward deflecting capacity, instead of "standing up to its work" against the opposing curves in its immediate front, it would splash and spread downward into the open space below, and afterwards glide out leisurely and inefficiently between the edges of the floats. The opening of the gate at the top, and then forcing the water *so entering the wheel* downward upon the lower curved portions of the floats *before leaving the wheel*, were both parts of one intelligently conceived system of producing efficient

part-gate as well as full-gate results. With this system in view, Swain intentionally placed the curved crown and the curved bottom of the floats *within co operating distance of each other*, and relied upon their conjoint action, and the consequent diagonal discharge, to prevent the "water from leaving the wheel until its force had been properly expended upon it," and the paraboloidal impinging face of the float was a part of the same system. It is only necessary to imagine the defendant's wheel with its horizontal crown, and its elongated buckets with their *cyma-reversa* faces, placed in Swain's gate opening at the top, to see that at quarter-gate, the wheel would not act efficiently at all.

The water would be, in effect, admitted to a centre-vent wheel without any lower rim.

(*C*) *From the state of the art preceding Swain's invention.*

The crown element was old, whether considered as a cover to the wheel or to the floats only. Complainant's Exhibit G, conceded to antedate Swain, shows a crown used for both purposes. This crown does not possess, however, the downward curvature of Swain's crown. The crown element, as such, is as old as the turbine, and long antedates Swain's.

Swain, then, invented, if he invented anything pertaining to the crown, the feature of downward curvature, terminating in the internal plug or core surrounding the shaft and holding the water to its work on the bottoms of the floats.

The float element, as characterized by the feature of *a discharge line extending from the crown to the peripheral band*, is clearly and *confessedly* shown in the Greenleaf patent of May 16, 1854, where it is combined with both crown and band. (Defendant's Exhibit 10.)

"There is one thing," says Mr. Waters, "in the Greenleaf wheel which *is* like a corresponding thing in the Swain wheel, and that is the cross-section of the discharge aperture of the wheel." (Waters' Dep., p. 195.)

Upon this Mr. Renwick remarks, "Mr. Waters next says that there is one thing in the Greenleaf wheel which is like the Swain, namely, the cross section of the wheel, by which, as I

understand it, he means the edges of the buckets, at the point of their discharge, are substantially the same in shape in the plaintiff's wheel and in the Greenleaf wheel. *I agree with him in the statement entirely.*" (Renwick's Dep., p. 203.)

There is nothing new then in the discharge line of the buckets. The only newness resides in a conformation adapted to take the power of the water forced downward by the curved crown. If the Greenleaf floats are not paraboloidal, neither are defendant's.

The band element is confessedly old, being found in various structures antedating Swain. It is sufficient here to call attention to the fact that Swain admits, in reply to interrogatory 100, that the Whitney wheel antedates his invention, and that in it "the buckets were stayed at their outer and lower portions by a cylindrical band to which they are confined." (Swain's Dep., Int. 100, p. 143.)

This band, too, is shown in the Hartshorn (Whitney) wheel, which, by stipulation, dates back to August, 1856, while the evidence shows no trace of Swain's band, even as a fugitive mental conception, before 1858.

We conclude, then, that all the elements named in the various claims are older than the Swain invention. They have also been combined before, confessedly in the Greenleaf, and in various other structures, as we shall show hereafter, notably in the Whitney.

Swain's claims, therefore, can stand only, if they can stand at all, for his new modes or forms of combining those several parts as modified by him to adapt them to obtain the result which he employed them to obtain; and this new mode or arrangement of modified parts, together with the result obtained, is set forth clearly and correctly in the original patent, as we have seen, and it results that the reissue must be limited to his new assemblage of modified parts, or it is void altogether.

So construed, the claims would read somewhat as follows:

1. A water-wheel, the floats of which have parabolodial impinging faces *and* discharge lines extending in continuous *curves*

from the downward bent crown at their inner edge to the lower outer edge of the wheel, substantially as shown and described.

2. The combination in a water-wheel of downward bent crown, and band and floats, substantially as described, when combined and operating for the purpose specified.

3. The combination in a water-wheel of downward bent crown and floats, substantially as described, when combined and operating for the purpose specified.

5. A water-wheel having an effective diagonal discharge of the whole water, constructed and operating substantially as described.

It will not be pretended that defendant has infringed any of the above claims.

We have thus far undertaken to meet the charge of infringement as it was made in the testimony adduced by the plaintiffs to support their bill.

But we have now to meet a second and different charge of infringement made for the first time in *rebuttal*, through Mr. Waters, then for the first time produced.

"When," says Mr. Waters, "a wheel like 'Exhibit D' is put into a flume, and provided with a pitch, such as is represented at No. 3, p. 4, complainant's Exhibit O, *then* the mode of operation of the *wheel and pitch* is substantially the same as the mode of operation of the *wheel and pitch* described in the complainant's patent." (Waters' Dep., p. 192)

This after-thought has not a word or syllable in any of the claims to justify it.

Undoubtedly, a patent might have been once obtained for a combination between a wheel admiting the water peripherally, and a system of pitches, or sluices, conducting the water thereto; but that was the very thing which, Swain learned at the outset, had been done at the Boott Cotton Mills. (Swain's Dep., p. 130.) There is no new mode of operation, *quoad* the

combination of pitches *and* wheel, brought into operation by a change in the direction of the water *after entering the wheel.*

The claims alleged to be infringed, would be infringed by a wheel properly made for that purpose, whether the water was introduced by a pitch system or by a scroll.

Therefore, the appellee has not infringed.

II.

The reissued letters patent are void.

A. *The reissue is not for the same invention as the original patent.*

The original patent describes, as we have seen, a wheel, or combination of parts in a wheel, whereby, owing to the downwardly curving crown and the described shape of the buckets, all the water vented is discharged diagonally. Clear and explicit building directions for the construction of such a wheel are given. Thus:

> "*The wheel G, has its floats d, cast or constructed each of a single piece of metal. The face sides of the floats d, where the water impinges, are of paraboloidal form, whose axes are tangent to a circle to which the guides e, hereinafter described, are also tangents, and also to the curve at or near the outer circumference of the wheel. The bottoms of the floats are formed by revolving the curves on their axes.*" (Orig. pat., p. 19, Rec.

Again:

> "*The floats d, may occupy one-third the radius of the wheel, and have a depth of three-sixths of the same; the width of space occupied by the guides, e, may be the same as the floats.*" (Orig. pat., Rec., p. 19.)

Again:

> "When J is lowered the water strikes the floats with all the force and velocity due to its head, directly under the rim of the wheel, *which is so curved as to force the water down rapidly on the lower curved parts or bottoms of the floats*, the water not leaving the wheel until its force has been properly expended on it. The water is discharged down between the curb and wheel and lower curb H, and is turned outward by the base *c*." (Orig. pat., Rec., p. 20.)

All of these building directions, although well adapted to teach persons skilled in the art how to make the wheel, are eliminated from the reissue.

On the other hand, the reissue describes a construction of which it says:

> "By this construction of the arrangement of the crown and floats we combine an inward flow turbine and a downward-flow turbine effectively in one wheel, which gives greater area of discharge nearer the centre of the wheel, the floats having a discharge line equal to the height of the float in the well known Fourneyrou or Warren wheels, and that due to the width of the float in a radial direction, as in the Jouval turbine." (See Reissue, Rec., p. 21.)

If we ask what this construction and arrangement is, we find it to reside in a float having an upper *horizontal* edge, necessitating a horizontal under surface to the crown, and float surfaces entirely different from the float surfaces of the orignal patent; thus:

> "The upper horizontal edge of the floats is attached to the crown of the wheel, and the outer lower edge *may*

be attached to a band. The surface of the floats *may* be curved in a horizontal direction at their upper portion, and have a curve of double curvature at their lower portion." (Se Reissue, Rec., p. 21.)

In fact the object of the reissue is to transform the diagonal discharge single wheel of the original patent into a double wheel having a *distinctive* center vent discharge, superimposed upon a *distinctive* vertical discharge.

We submit that this difference between the original and reissue cannot be reconciled by construction. Mr. Renwick testifies on this point as follows:

"In the reissue patent, in addition to the difference in the drawings before referred to, there are differences in the description; which differences are substantial and material. The description of the construction of the floats found in the old patent, and also the description of the flow of the water arising from the construction of the floats, crown and hub, are left out in the reissue, and in place of them a description is put in, which is in substance a description of the operation of the floats of the well known Leffel wheel, which is, in fact, a combination in one wheel of a Fourneyson and a Jourval Turbine. In the reissue it is stated that 'the upper horizontal edge of the floats is attached to the crown of the wheel.' Now, there is no horizontal upper edge to the float in the original patent, either described or represented in the drawing; on the contrary, the upper edge of the float, when projected upon a vertical plane, is not horizontal, but curving downwards, as it extends inwards in conformity with the shape of the crown. This description of the reissue describes the upper part of the float, or bucket, like those shown in Exhibit G, and does not describe that shown in the original patent.

The only further description of the floats in the reissue, is that they may (not are or must) be curved in a horizontal direction at their upper portion, and have a

curve of double curvature at their lower portion. This description is vague, indefinite, and would apply to a multitude of forms of buckets. By this construction, whatever it may be, the reissue goes on to state that an inward flow turbine and a downward flow turbine, are combined effectively in one wheel, having a discharge line equal to the height of the float in the Fourneyson wheel, and also that due to the width of the float in a radial direction, as in the Jounval wheel. As I have before stated, the wheel of the original patent discharges neither like the Fourneyson nor the Jounval, and I consider this statement, that buckets may be formed so as to discharge in those two ways, as an entire departure from the invention described in the original patent. Further, even the wheel shown in the drawings of the reissue, altered in form and proportion, as it is, from the original, would not discharge in the manner described in the reissue; the fact that it would not so discharge being proved by the shape of the edges of the buckets, as shown in the drawing, by the shape of the under side of the crown, and by the presence of a part of the crown and the hub in the centre of the wheel; this obstruction in the centre of the wheel filling up the space which is absolutely necessary for the horizontal discharge of the water in a centre discharge Fourneyson turbine. If the wheel had been formed in order to combine an inward flow turbine and a downward flow turbine effctively in one wheel, the crown of the wheel would have been horizontal on its under side, or nearly so; that part of the crown within the inner edges of the bucket and the hub would have been dispensed with, so as to permit free escape of the water towards the centre of the wheel and without downward deflection, and the shape of the discharge edges of the buckets would have been altered in the manner before pointed out, and, if the engineer had known how to produce the best effect, the lower inner edges of these buckets of altered shape would have been closed up by a solid ring, so as to force a portion of the water directly downard in the manner

in which it is so forced by the solid ring which shuts up the inner edges of the buckets in Exhibit H." (Renwick Dep., Rec., p. 123).

This new compound function is said in the reissue specification to reside in "*this* construction and arrangment," referring to a previous description already quoted in part.

"This construction and arrangement" is irreconcilable with the construction and arrangement which the original patent specifies, and to which it attributes an important mode of operation, and consequently these directions of the original patent are stricken out. It was fatal to the new pretension that the curved crown and curved bottoms of the floats should be within *co-operating* distance, and therefore the passage giving the height and breadth of float as compared with the wheel's diameter, is stricken out. It was fatal to the new pretension that the crown should be so curved as to act in co-operation with the 'lower curved part of the 'floats,' and therefore the passages describing this construction and operation are stricken out, as was also all reference to the paraboloidal curve. We say it was fatal, and we say it upon Hibbard's authority (complainant's expert), who says, "And the language quoted [when J is lowered, &c.], also implies an action of the water which is inconsistent with the action of the water in centre vent wheel, which is the action of the upper part of the wheel; because the action of the water in the upper part of the wheel which escapes inward would intercept any *immediate action or relation* between the form of the crown above the central discharge, and the lower part of the wheel where this discharge is downard, for obvious reasons." (Hibbard dep. 271, 272.) Or, in other words, the centre-vent feature of the double wheel, patented or attempted to be patented in the reissue, cannot reside in a structure in which, *as in the original Swain, the crown and lower curved parts of the floats have an immediate co operative relation.*

And it may be taken as axiomatic in this investigation, that a wheel in which an effective combination of "the inward flow and discharge" and "the downward flow and discharge" resides, must be a wheel in which the *direct* relation of the under side of the crown, and the bottoms of the floats, is as effectually prevented *as if it contained the diaphragm of the Leffel.*

Such a wheel is the defendant's, in which no water is forced downward by the crown into the lower curved parts of the floats.

Such a wheel is the one which the reissue seeks to cover by interpolating as new matter the horizontality of the crown and the elongation of the float discharges.

Such a wheel is not the one invented by Swain, and sought to be covered by his original patent.

B. *The fifth claim is functional in is character, and the reissue is, therefore, void.*

It makes no reference to the specification.

Even if it did, no help would come from that source as the specification does not describe a wheel capable of performing the function or functions sought to be patented.

> "There is no mechanical construction described in the specification, or represented in the drawings, which will perform the functions referred to unless the words commencing 'by this construction and arrangement' are held to be a description of the manner of constructing a wheel. I do not consider them as such a description; and the drawings clearly represent a wheel which will not perform those functions, and represent buckets which do not have a 'curve of double curvature at their lower portion,' which is the description given of them in the patent." (Renwick Dep., Ans. 8, p. 127.)

In fact, it is questionable whether Swain's original patent in any way suggests that the wheel *proper* is of his invention.

Of the four claims now alleged to be infringed, not one is found in the original patent.

Nor is there, in the original patent, a single claim relating to either crown, band or float, either alone or in combination, or sub-combination or arrangement.

The advantages claimed for the wheel have nothing whatever to do with the combinations patented in the reissue.

> "The advantages possessed by this wheel over others of a similar class are: 1, the wheel has not that great weight of water bearing on it to wear the step away; 2, the wheel may be readily raised without removing it from its proper working position; 3, all parts are very accessible for repairs, and removable at pleasure; 4, it is lighter than the majority of wheels, and may be started with less water, and run up to speed with far less water than is required by scroll wheels." (Orig. pat., p. 20.)

They relate to relieving the crown of the great weight of water which, in some former wheels rested upon it; to raising the wheel without removing it; to accessibility for repairing, and to the advantages derived from surrounding it by a system of pitches or chutes instead of a scroll.

And the only claim limited to the wheel proper is the third, as follows:

> "*Third*, The adjusting of the block E by means of the bar b, and set screws c, for the purpose of adjusting the wheels, to compensate for the wear of step."

And this claim involved the use of the conical core, whose presence is fatal to the function which the reissue seeks to cover in water-wheels.

Is it possible to hold that it was by accident or inadvertence that Swain failed to cover functions that could not be discharged in the same wheel with other functions which he sought to accomplish, and did accomplish, and covered by an appropriate claim?

The specification of the original patent affords no evidence

either that Swain attempted to secure what he now claims, nor does it even declare or suggest that as to them he was the original inventor.

The statute limiting reissues to the same invention, has been construed by this Court so as to prevent patentees from interposing barriers in the path of subsequent inventors, and arresting the progress of invention.

Burr v. Duryea, 1 Wall., 575.
Seymour v. Osborne, 11 Wall., 516.
Gill v. Wells, 22 Wall., 1.
The Wood Paper Patent, 23 Wall., 599.
Giant Powder Co. v. Powder Works, 15 O. G., p. 289.

(C) *The reissue is void for want of novelty.*

The wheels set up in the answer, with reference to which evidence has been taken, are,—

The "Temple" wheel,
The "Whitney" wheel,
The "Greenleaf" wheel,
The "Stowe" wheel.

The Temple wheel is described in Letters patent, No. 22,902, granted John Temple, February 8, 1859, and is represented by Exhibit 12 (p. 214).

It is also shown in duplicate of Patent Office Model Exhibit 13:

> "It [the Temple wheel] is substantially identical with the wheel of the Swain original patent, and with the Whitney wheel, except in the curve of the buckets, as cut by a horizontal plane, or a plane perpendicular to the axis of the wheel, and in the shape of the lower part of the buckets. The original Swain patent describes the buckets as of parabolic form. In the Temple wheel

> they are of a *cyma-reversa* curve on their acting faces, and at the bottom they do not fine away to nothing at the band, *and do not have their inner edges in a regular curve extending from crown to band, as in Swain and Whitney;* but, on the contrary, are so shaped as to give a small amount of effective downward or Jonval discharge, in addition to the oblique downward and inward discharge of the greater part of the water. But this wheel, like the Swain original and Whitney wheel, has a crown extending downwards and inwards; has a band to which the outer lower edges of the floats are attached, and also floats having their discharge line extending from the crown at their inner edge to the lower outer edge, where they are connected to the band." (Renwick's dep., p. 125).

Here, then, is a wheel having the combination of crown, band and floats, the latter having a discharge line from crown to band The floats "do not have their inner edge in a regular curve extending 'from crown to band, as in Swain's and Whitney;" but the crown and curve of the float are separated by a long vertical line, as in all the compound wheels known in the market, including the defendant's, thus giving the requisite height of float and induction port and discharge line for the double wheel, *if only the crown were horizontal within the limits of the floats.*

If, therefore, it be immaterial, as complainant claims, whether the crown be horizontal or curved, the Temple wheel is a complete answer to the reissued patent; *and it is immaterial*, unless, as defendant claims, the reissue is void.

Therefore, for the purpose of this case it is a complete answer, *unless the complainant invented the double wheel before February* 8, 1859, the date of the Temple patent.

But the various exhibits put in evidence for that purpose, while very suggestive when considered with reference to the time when Swain conceived his method of producing a wheel adapted to use in connexion with a vertically varying gate system, contain no suggestion whatever of *that* combination of crown, band and floats which is described in the reissue, and in

virtue of which it is claimed to be a compound wheel. Not one of Swain's wheels, or drawings of wheels, back of February 8, 1859, contains a float having the requisite elongation or shape to meet the conditions of the double discharge.

Nor does it anywhere appear that, before the date of his patent, Swain represented, described or suggested a wheel having that discharge capacity which the reissue calls for, and which, for the first time in the history of the art, appeared in the Temple wheel; *wherefore the latter wheel is a complete answer in this case.* The Temple wheel is illustrated by drawings 6 and 7.

THE WHITNEY WHEEL.

The Whitney wheel (see figs. 8 and 9) dates August 1, 1856, as appears by stipulation, referring to letters-patent No. 42,708 for a description thereof (Record, p. 9).

The letters-patent are copied on page 213, and the invention described therein is represented in the model Exhibit 14. (Renwick Dep., Ans. 5, p. 124.)

This wheel is declared by Mr. Renwick to be identical with the wheel described in the original patent to Swain, in so far as *the crown* or rim, the buckets and the band, and the mode of operation resulting therefrom is concerned.

> "Ans. The wheel described in the patent to Waldo Whitney, Exhibit No. 14, is identical with the wheel described in the original patent to Swain, in so far as the crown or rim, the buckets and the band, which unites the outer edges of the buckets at their lower parts, are concerned. It is also identical with the Swain wheel in its mode of operation, resulting from the construction of the crown, buckets and band. It differs from the Swain wheel somewhat in proportion, in the fact that the band is broader and that the crown descends more rapidly as it goes inward; and it is wanting in that part of the crown and hub which, in the Swain wheel, lies inside the inner

edges of the buckets and chokes up the space for the discharge." (Renwick Dep., Ans. 6, p. 125.)

And all differences are formal.

"Int. 7. For the purposes of the mode of operation resulting from the combination of the crown, buckets and band, as described and shown in the original Swain patent, do you regard the differences of construction which you have pointed out, between the wheel in the Whitney patent and the wheel in the original Swain patent, as substantial, or as merely formal?

(Objected to as to No. 3.)

Ans. As merely formal." (Renwick, Ans. 7, p. 126.)

The comparison involves the substantial identity in construction and mode of operation of the similarly related parts. Mr. Renwick's testimony leaves no room for cavil. And Swain admits that the Whitney is the older wheel, as before stated. (Swain's Dep., Ans. 100, p. 143.)

THE GREENLEAF WHEEL.

The Greenleaf wheel (see figs. 10 and 11) bears date May 16, 1854, and is found on page 208 of Record. No pretence is made that it does not antedate Swain.

Mr. Renwick testifies that the discharge edges of the buckets are the same (p. 203).

Mr. Renwick adds, "that it is evident, from the mere inspection of this Model No. 1 [Greenleaf] that it has a crown, that it has a band, and that it has floats or buckets having their discharge line extending from the crown, at their inner edge, to the lower outer edge of the wheel." (Renwick's Dep., p. 203.)

This the complaints do not deny; but they say,—

That the Greenleaf was not a horizontal wheel;
That the buckets in horizontal section are different;

That the vortex, in the centre of which the Greenleaf is placed, is produced by a scroll;

That the number of buckets are too few.

The first objection has no weight. It is perfectly obvious that the improvement is in no way conditioned to any one posture of the shaft.

That the floats in horizontal sections are *cyma-reversa*, instead of paraboloidal, would be material if the plaintiff had not eliminated the paraboloidal feature by his reissue, and if the defendant did not use the *cyma-reversa* float also. Mr. Renwick disposes of this objection (p. 203).

That the vortex in which the Greenleaf rotated was produced by a scroll, is immaterial. It appears that for twenty-five or thirty years at least, the scroll and guide have both been used for guiding water to a water-wheel, and that each may be substituted for the other. (Renwick's Dep, Ints. 4, 5, 6, p. 205.)

That the buckets are few, is of no consequence. The number of floats was stricken out of the reissue. Besides, "the Greenleaf wheel, without any change of form of bucket, could have eight buckets put in, at least, and as many more as might be desirable, if the shape was changed *in the usual way.*" (Renwick's Dep., p. 205.)

Besides, if number be material, the complainant's wheel, as described in the original patent, and shown in a model, has nearly twice as many buckets as the defendant's. (Renwick, p. 205.)

It should be added that Mr. Renwick states that the Greenleaf wheel would be practically successful and give a fair percentage of useful effect (p. 505). The Greenleaf wheel is, therefore, a complete answer, except as the paraboloidal floats which the defendant does not use.

THE STOWE WHEEL.

Three wheels of this kind were made and used long before the date of Swain's invention. The first was made in 1837. (Stowe's Dep., Ans. 4 *et seq.*, Rec. p. 38.)

The second was made in 1841. (Stowe Dep., Ans. 23 *et seq.*, p. 40.)

The third was made in 1850. (Stowe Dep., Ans. 39 *et seq.*, p. 42; Small's Dep., Ans. 9 *et seq.*, p. 80; Weeden Dep., Ans. 8 *et seq.*, p. 94; Dodge Dep., Ans. 4 *et seq*, p. 105.)

Each of these wheels had crown, band and floats, and the floats had discharge lines extending from the crown at their inner edge to the lower outer edge of the wheel at the band. (Exhibits 2, 3 and 7; Stowe Dep., p. 39, Ans. 10 to 19 inclusive; and from 26 to 31 inclusive; Small Dep., Ans. 17 to 33 inclusive, p. 80; Weeden Dep., Ans. 13 to 29 inclusive p. 94; Dodge Dep., p. 106, Ans. 15 to 28 inclusive.)

And the float in horizontal section was paraboloidal in shape, like Swain's. (Stowe Dep., Ans. 12, 13, p. 39.)

And Stowe continued to make these wheels, at intervals, down to the present time.

And is at present employed in making them, and did not know, till quite recently, that any other person claimed to have invented the same wheel. (Stowe Dep., Ans. 70, p. 44.)

The water was conducted into the wheel in such a way as to utilize the inward and downward discharge. (Stowe, Weeden, Small and Dodge, above cited.)

It is immaterial that the pitches did not extend all the way around the wheel. (Renwick Dep., p. 206.)

The Stowe wheel is a complete answer, if a wheel with a curved crown can be answered by a wheel with a flat crown.

III.

ABANDONMENT.

The answer alleges as defense that the subjects of the claims on which infringement is charged, were, before the grant of the reissue in suit, *abandoned and dedicated to the public.* This is so,

if the plaintiff now claims to cover wheels having a flat under surface of the crown.

The evidence is, that in 1859 Swain made and publicly used a wheel having a flat crown which did not force the water downward on to the bottoms of the floats. He afterwards made and used wheels like those described in his original patent.

> "On the plaintiff's own statement, as to a wrench made by him, like the Littlejohn wrench, in 1867, when he was experimenting upon wrenches, it is apparent that, having found it practically a failure, for whatever reason, he abandoned it, and did not attempt to include it in his patent. His device was the interlocking V-shaped projection and cavity. With the two devices present in his mind, no man could have chosen words so exclusively applicable to one, intending to include the other also, so that I feel no doubt in the conclusion that the plaintiff's patent not only does not, but was not intended to, include the Littlejohn form of wrench."
>
> Cornell v. Littlejohn, 9 O. G., 923.

The same doctrine is laid down in Evarts v. Ford, 5 Off. Gaz., 58.

IV.

COMPLAINANTS' TITLE.

The complainants' bill cannot be maintained, because they have not proved their title to the Swain patent at the date of bringing suit.

The assignment from the "Swain Turbine Company" to the complainants (p. 261) purports to be "subject to certain conditions named in the memorandum of agreement made and executed on the second day of June, 1874," &c.

The answer does not admit title.

At the time of the introduction of this assignment in evidence, the defendant objected to it for want of production of the memorandum of Juue 2 (Record, p. 18).

The testimony shows that the memorandum is still in the possession of the corporation; and the counsel for the defendant called upon the complainant to produce the memorandum, and the counsel for complainant took time to consider whether or no they would produce it, and closed their testimony without doing so (Record, p. 36).

Wherefore the decree of the Court below should be affirmed.

Respectfully submitted

Mitchell & Humphrey

of Counsel

DEFENDANT'S WHEEL.

Fig. 1.

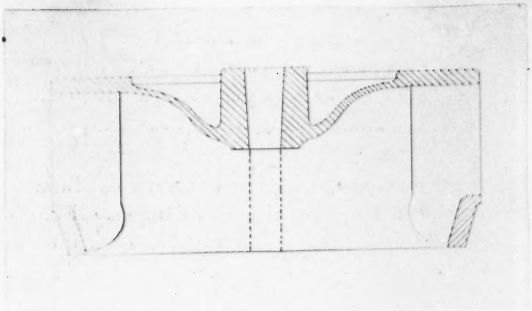


Fig. 2.



Fig. 3.

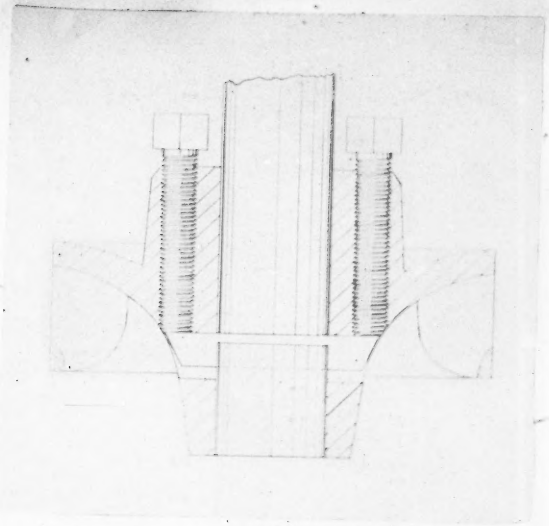
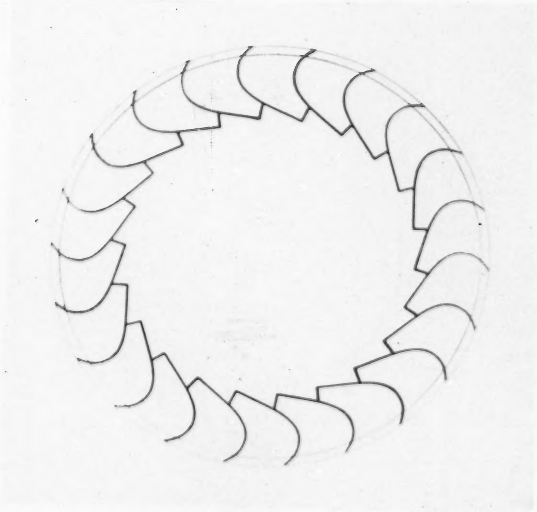


Fig. 4.



TEMPLE WHEEL.

Fig. 6.

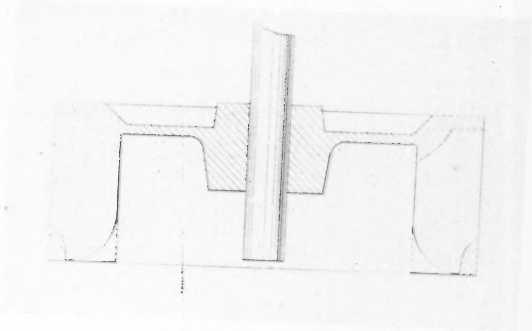


Fig. 7.

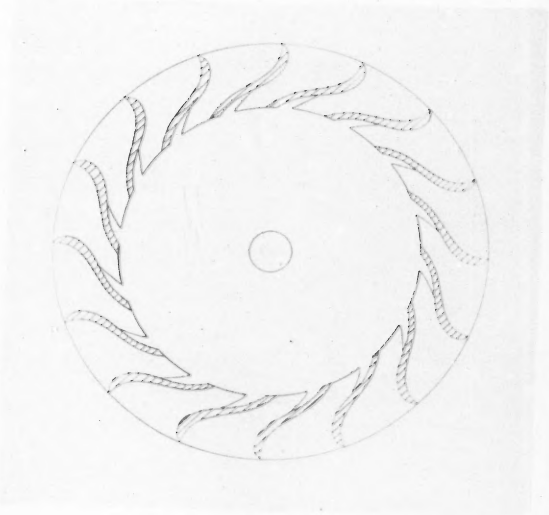


Fig. 8.

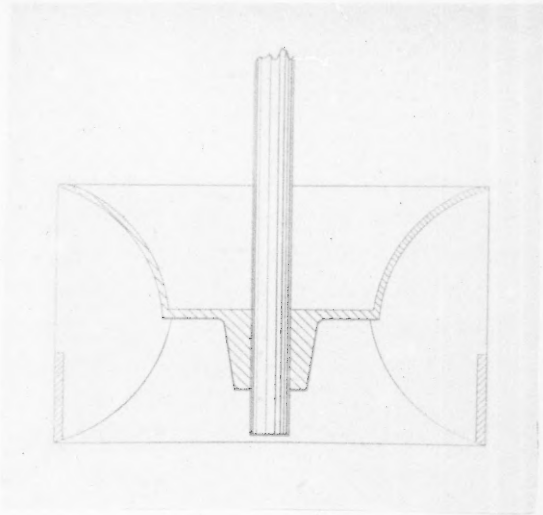
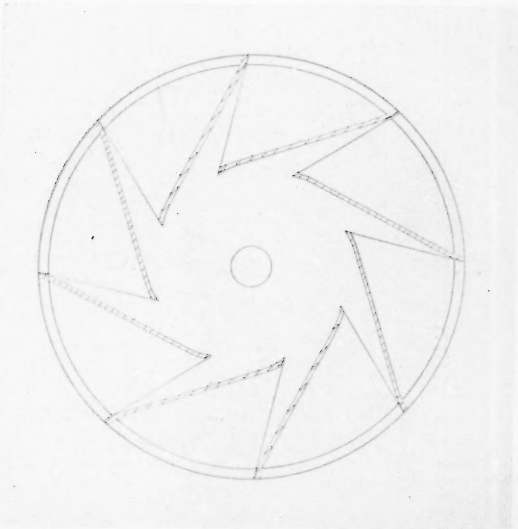


Fig. 9.



GREENLEAF WHEEL

Fig. 10.

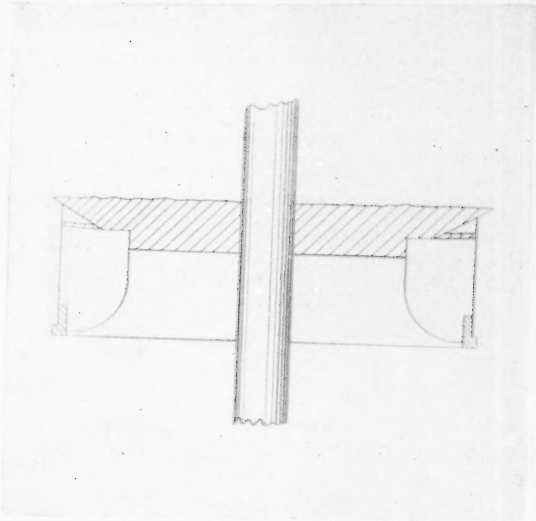
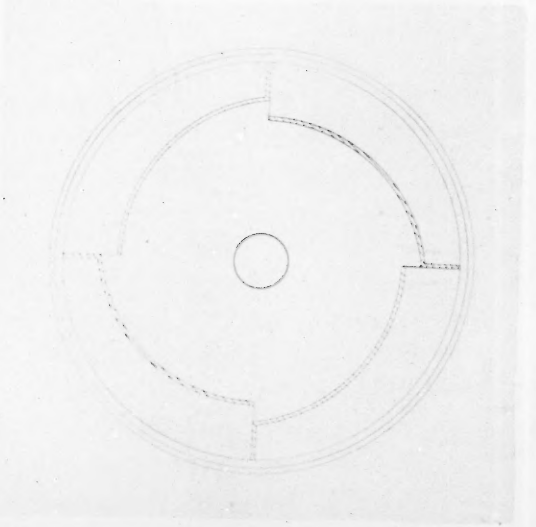


Fig. 11.



STOWE WHEEL.

Fig. 12.

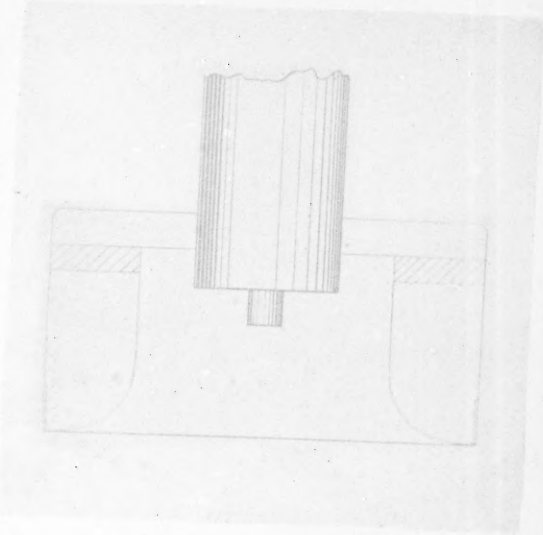


Fig. 13.

